Huge Website: See Your House From Space!

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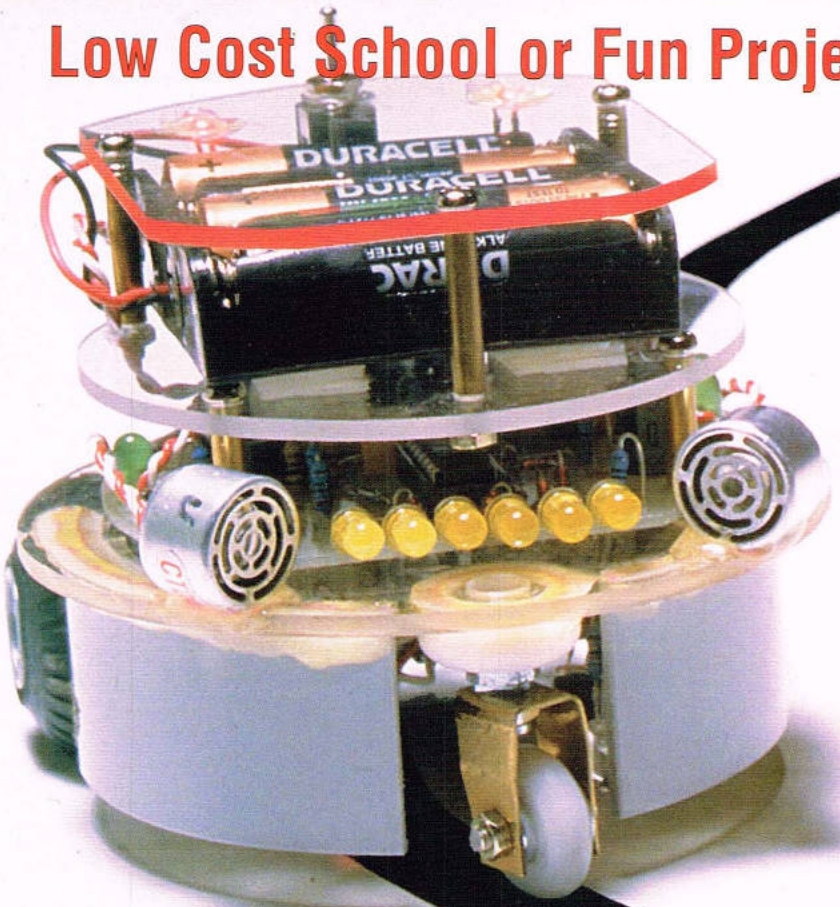

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CARBON MONOXIDE WARNING ALARM

Just for Mother's Day!

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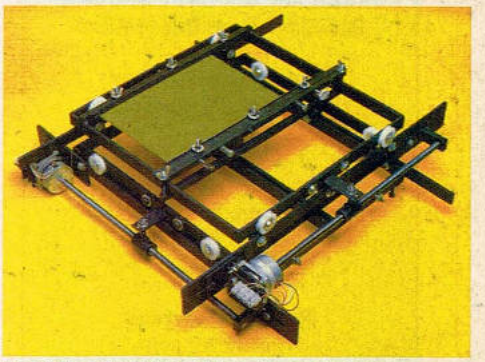

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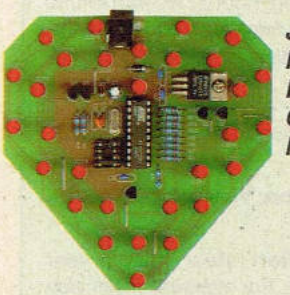

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Printing: Macquarie Print, Dubbo, NSW.

Distribution: Network Distribution Company.

Subscription rates: $59 per year in Australia. For overseas rates, see the subscription page in this issue.

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ISSN 1030-2662

* Recommended and maximum price only.

PUBLISHER'S LETTER

GPS navigation in cars

How many times have you been really frustrated as you drove down an unknown city street? While I know Sydney comparatively well, there have been times when I have been completely lost, in spite of the fact that I had an up-to-date street directory open on the seat beside me. One of the big problems, in Sydney at least, is that there just aren't enough street signs and some of the signs on major highways are downright misleading.

On some long streets in Sydney, you can travel for kilometres without seeing a sign which clearly identifies the street you're actually on. And many a driver has been unwittingly forced to cross the Harbour Bridge, the Harbour Tunnel or has entered a tollway because of confusing signs. I am sure that this is partly because the bureaucrats who design the signs never actually travel on the roads where they are posted.

But now there is a solution in the form of GPS navigation in cars. This has been available for a number of years in up-market BMWs and in recent months has been available as a no-cost option in Hyundai Sonatas. And it has just been released as an option in Holden Commodores. The system covers Sydney, Melbourne, Brisbane, Perth, Adelaide and Canberra, as well as major highways. It draws information from three local global positioning satellites, maps on CD-ROM and the vehicle's speed and direction to guide you through a maze of city streets.

Your car is actually depicted on an on-screen map, with all the streets identified. And the map moves as you drive along, which is a big advance over what happens when you are using a street directory – when you change the page you have to orientate yourself again.

You can set up the system to give you voice prompts along the way to a particular location and it will give you plenty of warning of up-coming turns; with calm, measured suggestions in dulcet tones. This could be a real boon for me - some of the most heated arguments I've ever had with my wife concerned street directions. Why is that? What is it about driving along unknown streets that causes stress with your loved one?

Mind you, even with GPS navigation in a car, I'm not sure that there would not still be the occasional uttered swear word. Let's face it: city streets will still be city streets and the traffic will still be the same.

On the other hand, the GPS navigation system in the Commodore is pretty pricey at $4495, considering that the Hyundai Sonata's is at no extra cost and the cost of some handheld GPS receivers is now under $300. On the positive side, this technology can only get cheaper.

In the meantime, I might have to continue to make do with the street directory. Either that or catch taxis!

Leo Simpson

www.terraserver.microsoft.com

A web site that's Out Of This World!

By Ross Tester

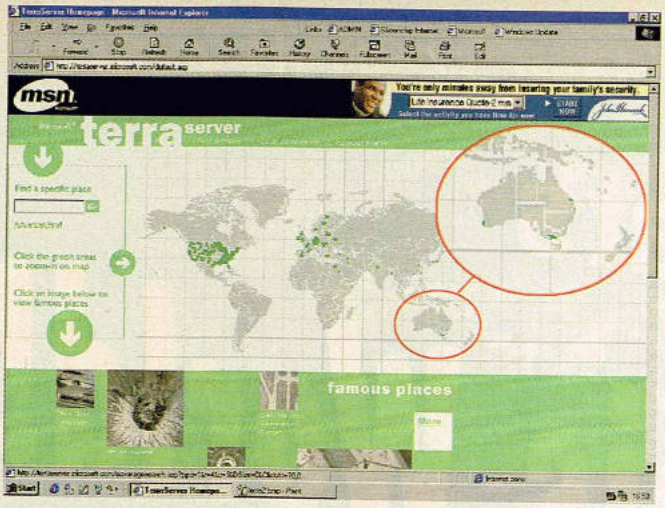
Recently we came across a web site that could be described as the world's greatest site – in the true sense of the word great, that is. www.terraserver.microsoft.com is, without doubt, the world's largest site and its contents could truly be described as "out of this world".

With more than 1.2TB of data, TerraServer contains more data than all the HTML pages on the web combined.

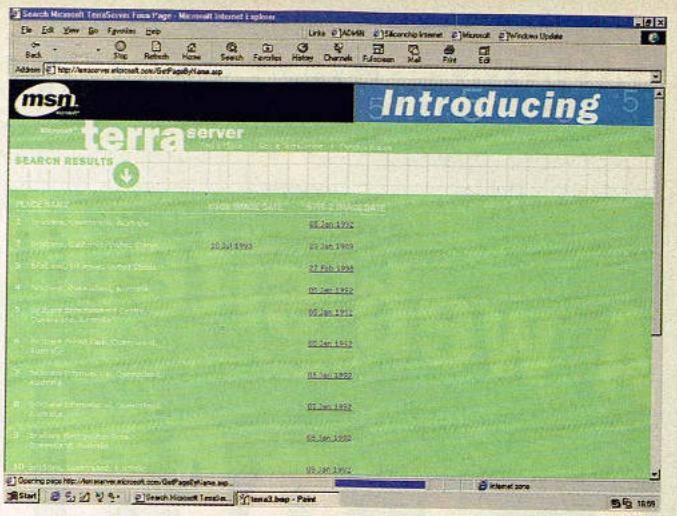
Hang on a minute, what's a TB? You've heard of megabytes (most web sites are less than 1MB). Next up the scale is the gigabyte (GB), or 1,000MB. A terabyte, TB, is 1,000,000MB or 1,000,000,000,000 bytes. That's equivalent to about a billion pages of text or four million books. Whew!

What occupies this mind-boggling storage space? Thousands upon thousands of black and white photographs of the Earth, taken from one of two satellites over the past decade or so. One of those satellites is courtesy of the United States Geological Survey and the other is from the Russian Space Agency, Sovinformsputnik.

The US satellite has concentrated mainly on the United States, while the Russians are responsible for most of the rest of the world. While most populated areas of the US are covered, the rest of the world is some-



You can point and click to anywhere on the world map shaded in green (we've enlarged the map of Australia to show the areas that *aren't* covered). The area under the map allows you to select a number of famous places.



Or you search for a city/area and see if it is covered. The two columns on the right show the images from the US (left) and Russian (right) satellites. Point and click on either to load the respective image.

what less represented – and patchy.

In Australia, Melbourne, Brisbane and Perth are all covered but for some reason, the centre of the Universe (Sydney, to those living in it) is not. Melbourne, Brisbane and Perth readers are probably saying "rightly so!"

Enough frivolity: let's get back to TerraServer. By a happy coincidence (?), tera not only means 10^{12}, add another "r" and you have the Latin word for earth.

The surface area of the Earth is about 500 square terametres (there's that word again!), of which about 100 are dry land. Of that, only about four square terametres are populated, the rest being mountain, desert, ice capped, farmland and so on.

The Soviets have so far managed to photograph about two square terametres, or about half of the populated area. While some of the information is getting a little dated (Melbourne, for example, was photographed in 1991), it is still a valuable source of information for a huge variety of people. The Soviet images, by the way, are called SPIN-2, a reference to that two square terabytes.

How does it work?

When you access the TerraServer web site, you are presented with a map of the world with photographed areas coloured green.

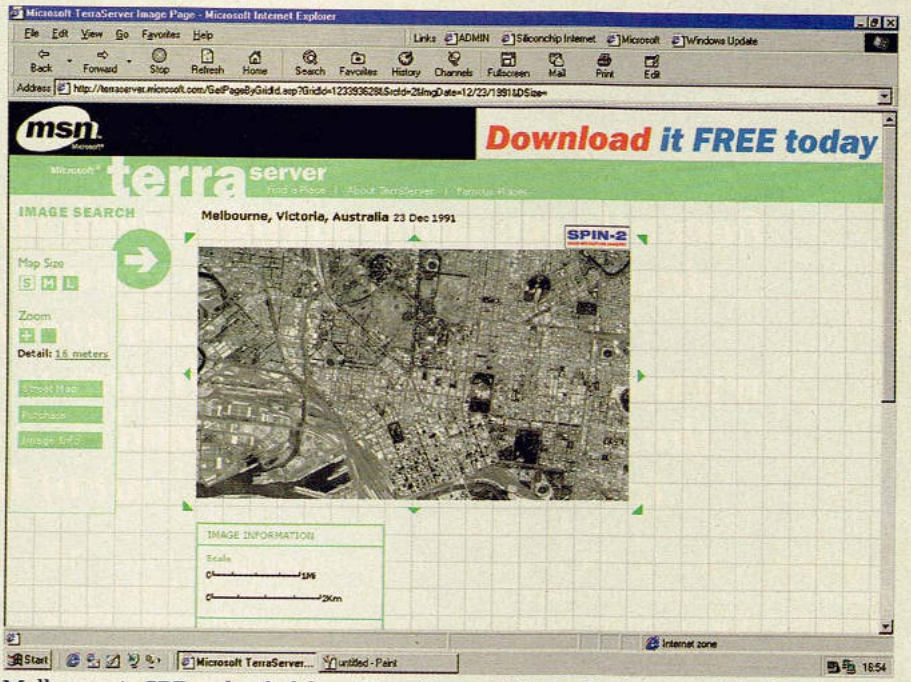
Click on any of these areas and the photographs for that area begin to download. When we say photographs, we mean just that: up to 16 photographs are assembled on screen with virtually seamless precision.

Those 16 photos will give you a base resolution of 16m to the centimetre. Click on an area of the photograph and the next resolution will load, this time at 8 to the centimetre. The highest resolution depends on the source of the photos: the US satellite pics are at the incredible resolution of 1m per pixel.

That's enough to pick out individual cars on a roadway but not, as you might have seen in spy movies, read their number plates or view the driver.

Incidentally, such resolution, in real time, is believed to be possible from many of the spy satellites now in use. Number plates with their 100mm high letters are said to be a doddle.

Fairly believable reports state that today's spy satellites are good enough to pick up the dateline on the front of a newspaper (usually about 12-14pt type) while less believable rumours



Melbourne's CBD as loaded from TerraServer. This is the lowest resolution image but even this is more than adequate to easily spot major landmarks – Docklands, the Yarra and the MCG, for example. We've also chosen the lowest size – this could be increased to full screen with the buttons on the left side of the screen. This montage covers roughly Ascot Vale in the top left to Richmond bottom right.

state that the latest generation of spy satellites can actually read the newspaper itself (usually 7 or 8pt type!)

But we digress – again.

The resolution from the Russian-sourced photos is not quite as good; they are at 1.56 metres per pixel. More importantly, though, if you want to view hi-res images from the Russian source, you have to pay for them.

But we imagine that most people using the site will be more than happy viewing the on-screen images (free).

Hey, look, there's our house. . .

Terabytes of storage

To hold, access and download Terabytes of information you might expect a system that's a bit more than an old AT with a big hard disc. And you'd be right!

The TerraServer system runs on a Digital Alpha 8400 system with eight (yes, 8) 440MHz Digital Alpha processors and a massive ten gigabytes (10GB) of memory (yes, memory!).

The machine is connected to seven dual-ported Ultra-SCSI host-bus adaptors, each of which interfaces with a disc drive cabinet containing 46 nine gigabyte drives.

Quickly doing a bit of mental arithmetic, 7 x 46 is 322 drives, plus the couple in the Digital Alpha 8400 – means a system with 324 drives totalling 2.9TB of storage. Using a RAID (redundant array of independent discs) setup, the drives are configured to act as four logical drives of 595GB each.

SQL Server Enterprise Edition stripes the database across the four logical volume. After taking the data-management overhead into account, the array has about 2.4TB of storage capacity. And if something goes wrong, there's a tape back-up which can handle 5TB of data.

The system runs on Microsoft NT Server V4.0 with SQL Server, already mentioned.

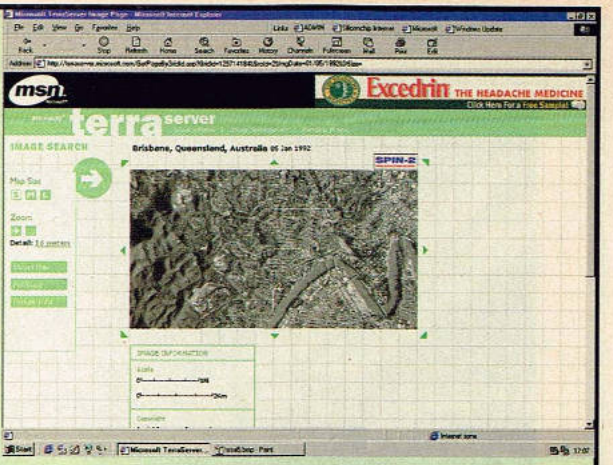
Who pays for it all?

Love 'em or loathe 'em, you have to take your hat off to the people at Microsoft for getting behind this project.

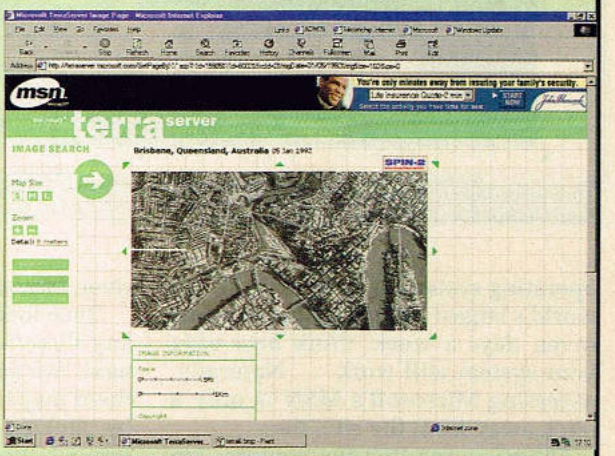
While the site is also supported by on-screen adverts (not too intrusive, as you'll see from the screen grabs), it would appear that Mr Gates and his team are the money behind it.

Of course, this is also an excellent advertisement for Microsoft and its

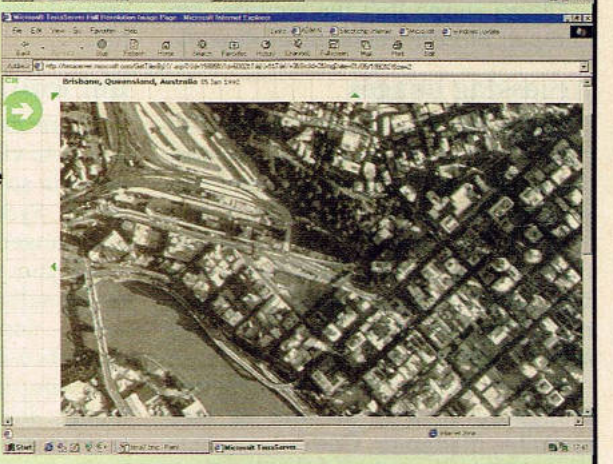
Here is the Brisbane CBD and inner west, photographed from space courtesy of the Russian satellite. This covers an area from about The Gap top left through to Kangaroo Pt in the bottom right. The white lines in the centre of this pic are where the joins between frames (automatically done on download) were not quite seamless.



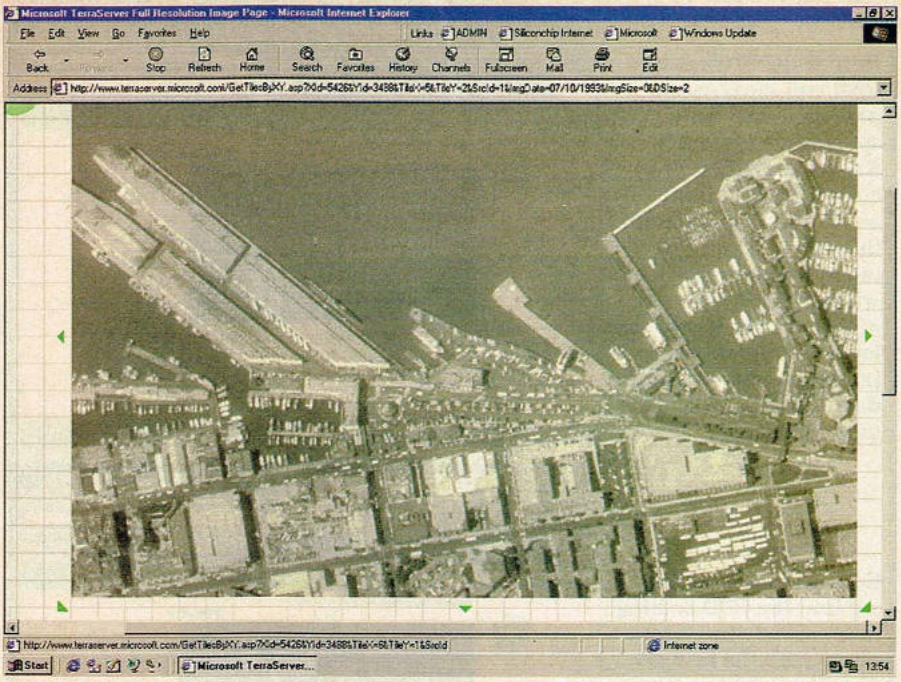
Enlarging up one step we find the CBD coming more clearly into view, along with the bridges over the Brisbane River. Note the shadow cast by the Story Bridge (right side) – obviously an early morning photograph. The advert (top right) helps pay for the site so it's free for you to browse.



We've enlarged again but this time also selected the larger view. We're looking here at Brisbane City, with the Roma Street station and goods yard along with the Brisbane River bottom left. At this scale you can start to pick out vehicles on the bridge and rail wagons.



Enlarged yet again to the highest resolution, this time back on the eastern City with the Story Bridge/Kangaroo Point on the right. Note the grey patches middle and lower left – these are glitches in the system which can sometimes be removed by refreshing the screen.


Microsoft TerraServer Full Resolution Image Page - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://www.terraserver.microsoft.com/GetTilesByXY.asp?Id=54261&Y1d=34986&TileX=6&TileY=2&SrcId=1&ImgDate=07/10/1993&ImgSize=0&DSize=2
Internet zone
Start
Microsoft TerraServer...
13:54

By way of contrast, here is an image of the San Francisco Fisherman's Wharf area, taken from the USGS satellite. There's not a huge amount to choose from in this screen image but remember you can download a hi-res image of any of the USGS files free of charge. The Russian SPIN-2 images are also available but you have to pay for them!

operating system: if it can handle the world's largest website 24 hours a day, seven days a week, think how easy your system will work. . . Naturally, accessing Microsoft's MSN is only a click away from the site, too.

Others supporting the venture are Compaq, Storageworks and Storagetek.

Accessing images

We've described how easy it is to "point and click" to obtain any area on Earth. But there's more than one way to skin a dead cat, so to speak.

You can also type a place name into the system's search engine and it will find ALL places on Earth with that name. (Bet you didn't know that there are 16 Sydneys, did you?).

If the location is on the database, alongside it will be one or two clickable filenames. One column lists the USGS images, the second the Russian images. If the name is present, clicking has the same effect as clicking a location on the world map. When it loads, the name of the location is shown above the photo image.

In fact, the name may be much more localised than you asked for: we loaded Brisbane by clicking on it, zoomed in and found that the name had changed to Petrie Terrace. Sure enough, our image showed the Brisbane suburb of Petrie Terrace!

You don't have to search for just a location, either: a pull-down menu lets you specify a qualifier such as river, bay, airport and so on.

Once loaded, you can also move in any direction from that photo to the next (we have difficulty not calling them maps, but they are real photos) by clicking on any of the eight green arrow buttons around the edge of the pic.

But wait, there's more!

There are also images of famous places to view (mainly US, of course), many in superb resolution. But where is the Sydney Opera House or the Coathanger?

As you might expect, the site is continually evolving and will – hopefully – contain many more areas in the not-to-distant future.

A couple of negative comments, though: downloading huge files (which is what you are doing) takes a significant amount of time. And the system is by no means perfect – we found several times that one frame out of 16 simply refused to load; or one, perhaps two frames were corrupted, with "holes" in them or areas not appearing.

Sometimes, the seams between adjacent frames did not quite work and a thin white line appeared.

And sometimes, frames simply refuse to load. In many cases, hitting the "refresh" tab cleared these problems, but not always.

It is more than possible that some of the limitations in the system were at our end. But whenever we do reports such as this, we want to use a system typical of that which most readers would have (we were using a mid-range 486 with a pretty good graphics card and a fast [56K] modem). One of these days we'll give it a fly on a fast Pentium II machine with heaps more "grunt" just to see how it goes.

Obtaining images

The vast majority of web surfers would simply visit the site to view places of interest. But if you want to obtain hi-res images, you can. If they are from the USGS satellite you can download them free of charge.

The Russian images, though, will cost you (they're actually provided by an American supplier – good ol' capitalism strikes again!). Details are provided on the web site.

If you get the impression that we're pretty impressed with www.terraserver.microsoft.com, you're spot on.

Not just because of its awesome size and power; not just because it's a site which will interest everybody; not just because it's a technological breakthrough; not just because of its ease-of-use and, to use a hackneyed term these days, "user friendliness". .

We're also mightily impressed that, even if the technology to do all this was available a decade or so ago (it wasn't!), can you imagine the Russians allowing Americans access to what would be (then) a top-secret photo library and then make it available to the world?

Let's just hope the spirit of cooperation which has seen this site evolve can find its way into other areas of technology. **SC**

Acknowledgement:
Much of the technical information in this article first appeared in the US magazine, Popular Electronics, March 1999. Screen grabs courtesy of www.terraserver.microsoft.com

MicroGram Computers

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Internet for everyone! Give all stations on your network simultaneous access to the Internet through this pocket-sized access server. Hardware based firewall ensures your security, while dial on demand minimizes your connect time. It has a built-in DHCP server & includes software to provide clients with their own email address. Provides one communication port (DB25) for Internet access and one RJ-45 port for connection to your 10Base-T Ethernet network. Supports easy Internet connection to your Internet Service Provider via modem or ISDN.

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100Mbps Network Starter Kit

This kit has all the hardware components required to build a 100Mbps network for two PC's and includes a comprehensive installation manual. The kit includes one 4 port 100Mbps Fast Ethernet hub, two 10/100Mbps PCI Fast Ethernet adapters, two 5 m Cat. 5 network cables & software drivers for the adapters.

Cat. 11900	**100Mbps Network Starter Kit**	$339

10/100 Mbps Ethernet Hubs

Each individual port on these dual-speed hubs provide 10/100Mbps auto-negotiation function which automatically senses and selects the optimum speed of 10Mbps or 100Mbps.

Cat. 11310	**10/100 BaseTX Ethernet Hub 5 Port**	$345
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Cat. 11298	**10/100 BaseTX Ethernet Hub 16 Port**	$999

10Mbps Ethernet 5 Port Hub & LAN Card

Internal PCI Plug & Play 5 Port hub and LAN card does not require external power supply. One port can be used as an uplink port for easy expansion, or used for hub connectivity at the server.

Cat. 11295	**Ethernet Hub & LAN Card 5 Port UTP 10Mb**	$109

10/100Mbps Ethernet Cards

Able to auto sense either 10Mbs or 100Mbs operation, this PnP PCI Ethernet card uses the Bus Master architecture to maximise throughput. Ideal for progressive upgrade of your network.

Cat. 11282	**Ethernet Card PCI UTP/STP 10/100Mbps**	$49
Cat. 11271	**Ethernet Card PCI BNC UTP/STP**	$35
Cat. 11272	**Ethernet Card ISA BNC/UTP PnP Jmp**	$35

100Mbps Ethernet 5 Port Hub Card

Mounts on the back plane of a computer but does not plug into a slot, it only connects to the power supply. No separate case & power supply means reduced costs, plus everything is kept neat & tidy inside the computer.

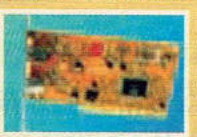
Cat. 11294	**Ethernet Hub Card 5 Port UTP 100Mbps**	$259
Cat. 11287	**Ethernet Hub Card 5 Port UTP 10Mbps**	$89
Cat. 11297	**100 BaseTX Ethernet Hub 4 Port**	$189
Cat. 11281	**100 BaseTX Ethernet Hub 8 Port**	$539
Cat. 11311	**100 BaseTX Ethernet Hub 16 Port**	$889

Enhanced Network Cable Tester

Tests a range of Modular cables including 10Base-T (Category 3-5), as well as AT&T 258A, EIA/TIA and Token Ring. Includes a remote terminator.

Cat. 11516	**Enhanced Network Cable Tester**	$129.

Two Port USB Card PCI



Provides 2 USB ports with a bandwidth up to 12Mb/s. Supports real time dynamic insertion and removal of up to 127 devices.

Cat. No. 2622	**Two Port USB Card PCI**	$109

USB to Parallel Converter

The USB to Parallel converter is a bridge that links the Universal Serial Bus (USB) interface with the traditional IEEE-1284 parallel interface.

Cat. 2685	**USB to Parallel Converter**	$89

ISA Cards

A versatile multi-I/O card that supports 2 FDD, 2 HDD as well as two 16550 compatible serial ports, 1 ECP/EPP printer port and 1 games port.

Cat. 2055	**Multi I/O Card ISA**	$55

An ISA VGA 16 bit graphics card with super-high resolution, 256-colour capability & fast screen redraw.

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A number of courses are "Microsoft Certified Professional - Approved Study Guides"

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Over 180 courses on offer

Infra Red Serial Links

Connect the IrJet via standard serial port for computers without a built-in IR port or directly to a motherboard with built-in IR port pin outs. A transfer rate of up to 115,200 bps is supported over 3.5 metres.

Cat. No. 8421	**Infra Red Serial Link**	$147
Cat. No. 8518	**Infra Red Motherboard Link**	$99

Removable Hard Drive Kits

Consists of a 5.25" mounting rack & a removable tray for 3.5" hard drives. A keylock prevents inadvertent or unauthorised removal. Applications include:

- securing confidential data in a safe overnight
- providing off-site backups
- easy interchange of OS (eg DOS to Windows NT)

Cat. No. 6049	**IDE Kit**	$111
Cat. No. 6048	**SCSI Kit**	$121
Cat. No. 6200 / 6224	**IDE Tray / Frame Only**	$70
Cat. No. 6201 / 6225	**SCSI Tray / Frame Only**	$76
Cat. No. 6327	**SCSI Fast Wide**	$169

VGA Monitor Splitters

Splitter modules enable up to 8 monitors to simultaneousy share the information of a host computer. An ideal way of providing multiple displays in training rooms, airports, clubs, etc.

Cat. 3070	**Two Output**	$269
Cat. 3055	**Four Output**	$336
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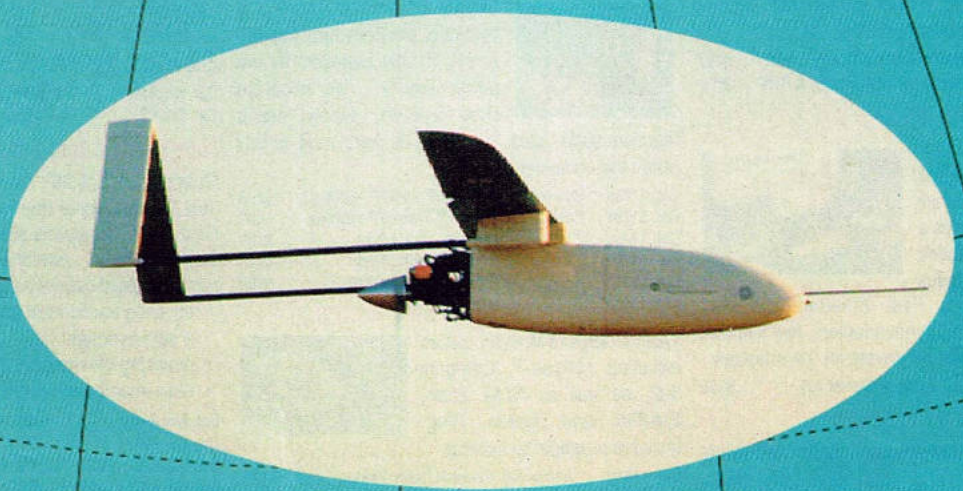


When most people think of radio controlled aircraft, they imagine small models that fly around a small field. But this Australian designed and manufactured aircraft has crossed the Atlantic and performed many other record feats.

The idea of a robot aircraft flying at 40,000 feet and with a range of up to 7000km takes some getting used to, especially when you realise that commercial jet aircraft fly at the same height and have a similar range.

Add in the fact that this radio-controlled aircraft has a wing-span of only three metres and weighs only 15kg and the feat is all the more incredible.

In what must be one of the least-publicised epics for some time, the North Atlantic was crossed by the Australian-designed Aerosonde robotic aircraft in August 1998. The Aerosonde was the first robotic aircraft to cross the North Atlantic Ocean and it was also the smallest aircraft ever to do so.

As you might imagine, for a crossing of the Atlantic the aircraft is not under radio control for most of the flight. Instead, the Aerosonde employs an autopilot and GPS fixes to guide it most of the way. So notable has this aircraft become that it is now a joint development with the US military and its future uses could be quite widespread.

The history-making Aerosonde, nicknamed "Laima," landed smoothly on a field at the Benbecula military range in the Outer Hebrides, Scotland, after a 27-hour non-stop flight from St Johns, Newfoundland, Canada.

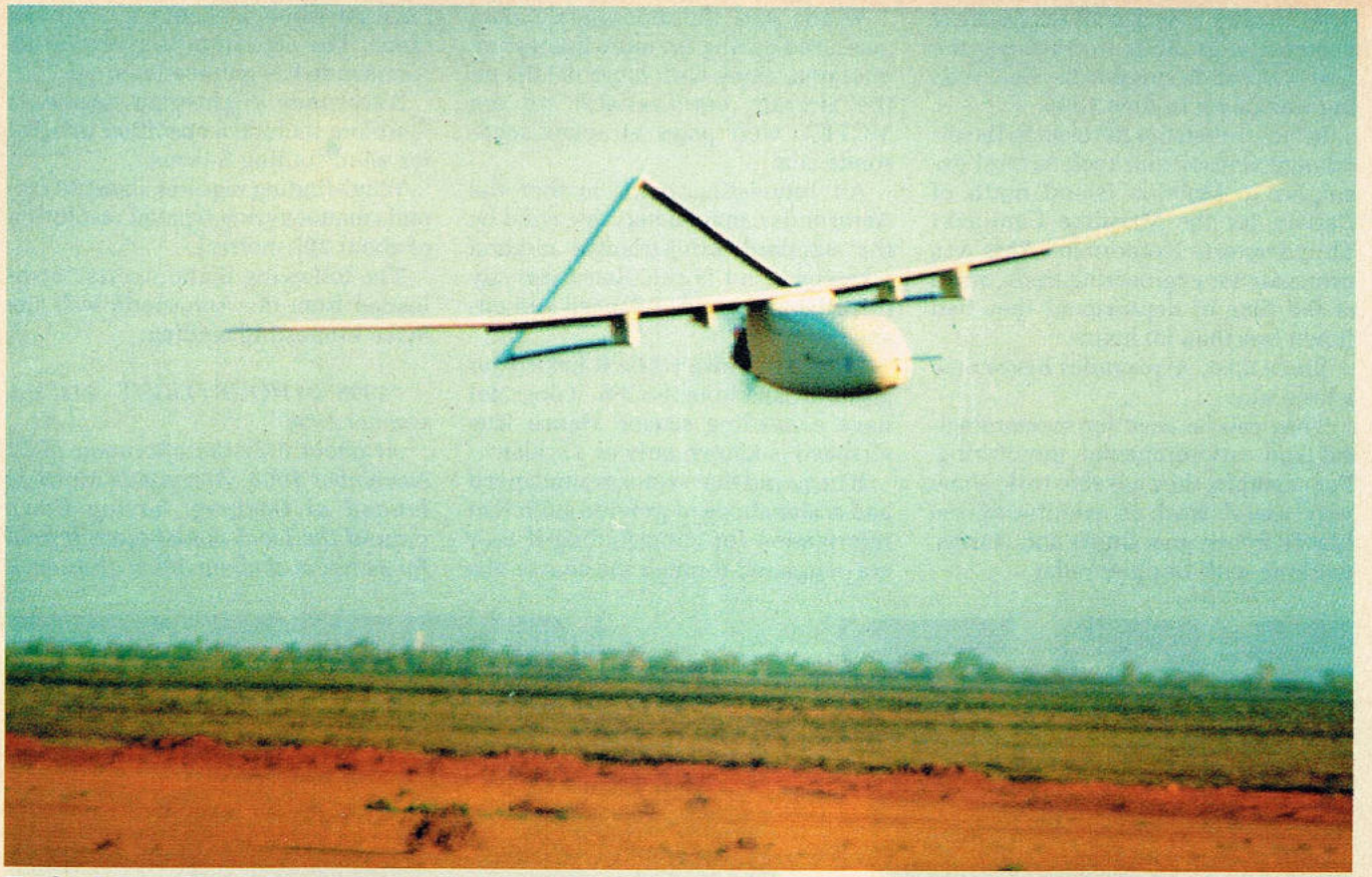
By BOB YOUNG

Powered by a tiny one-cylinder 20cc engine, the aircraft autonomously guided itself across the 3200km stretch of the North Atlantic while burning less than six litres of fuel!

The Aerosonde rigorously maintained a flight path approved by aviation authorities and landed exactly as scheduled while collecting meteorological data throughout the flight.

The tiny aircraft is packed with computers, a communications radio, a GPS satellite guidance system and meteorological instruments.

This crossing followed extensive trials held in Australia, Canada and Asia over the previous year. It followed a path similar to that taken by the first Atlantic manned crossing by Alcock and Brown.



Hard to believe, but as the tiny Aerosonde makes a low pass over an airfield it could be coming in to land after a flight of thousands of kilometres from who knows where.

The flight was conducted by the University of Washington and US engineering company, The Insitu Group, using aircraft purchased by the University from co-developer Environmental Systems and Services.

"We've flown the same mission as a $10 million unmanned craft at a fraction of the cost," said Professor Juris Vagners of the University of Washington Aeronautics and Astronautics department. The aircraft cost $US25,000.

Aerosonde development has been underway since 1992. Phase I Aerosondes were given their full operational trial by the Bureau of Meteorology in early 1998 and passed with flying colours.

In addition, Aerosonde RA have conducted several missions in Australia, Taiwan, Canada and the United States, including flights of over 30 hours and at 16,000 feet.

To date over 30 Phase I Aerosondes have been delivered. Their specifications are as shown in Table 1.

Aerosonde is currently working on a Phase 2 version which will have a range up to 7000km, up to 5 days endurance and a ceiling of 40,000 feet.

While Aerosonde resembles a model aircraft externally, this resemblance is purely superficial.

True, some components are essentially model aircraft components, however the operationing systems are structured along traditional military lines.

Take-off and landings are arranged so that manual or automatic control can be engaged. Manual control is engaged when the pilot plugs his control box into the computer control console. Currently, all take-offs and landings are done under manual control.

The Aerosonde uses a gyroscopic autopilot and standard model aircraft servos but the details of these have not been released.

The aircraft is a joint Australian/American design and manufacture has commenced at Melbourne. Component manufacture is contracted to a number of Australian and international groups.

Table 1: Phase 1 Aerosonde Specifications

Wingspan:	3 metres
Weight:	15kg
Engine:	20cc petrol (Avgas)
Performance:	Cruise 20-30m/s
Range:	>3,000km,
Endurance	>30 hours
Height Range:	Surface to 16,000 feet
Payload:	1-2 kg
Operation:	Autonomous
Navigation:	GPS
Communication:	UHF Radio, Satellite
Observations:	Wind, Pressure, Height, Temperature, Moisture

Following a series of engineering demonstrators built in 1992-94, the first Aerosonde suitable for field testing was flown in June 1995.

In November, the Aerosonde Development Consortium took several examples to Melville Island north of Darwin for the Maritime Continent Thunderstorm Experiment. This was primarily for engineering trials, since at the time of deployment they had flown less than 50 hours

Since then, Aerosondes have come a long way.

They can be used for meteorological and environmental monitoring. For example, they are able to do some very useful work in monitoring sea breeze fronts, gust fronts and storms, working with Doppler radar.

Winds and thermodynamic data measured during the more interesting missions, along with more details on the aircraft, are available on the MCTEX web page at www.aerosonde.com

An interesting point is that the Aerosonde cannot determine wind by the standard wind-triangle method whereby wind is calculated directly by differencing groundspeed and airspeed vectors.

This is because while it has vector groundspeed from its GPS, it does not have a heading sensor. Hence true airspeed is known only as a scalar.

It turns out that vector groundspeed and scalar airspeed provide sufficient information for wind-finding if they are compared through the course of a turn, say through about a quarter of a circle. The algorithm is given in the Aerosonde RA publications.

Aerosonde flight-plan segments therefore include a specified interval for wind-finding S-turns.

Wind-finding requires about 10 seconds manoeuvring (spatial resolution of about 200 metres).

The following flight reports downloaded from the Aerosonde web site make interesting reading:

"1996: 24 HOUR FLIGHT - 21st November 1996

At about 5 in the afternoon of 21 November 1996, Aerosonde Morticia landed at Geelong, having flown around the local model-aircraft field for 24 hours at about 300m altitude. It

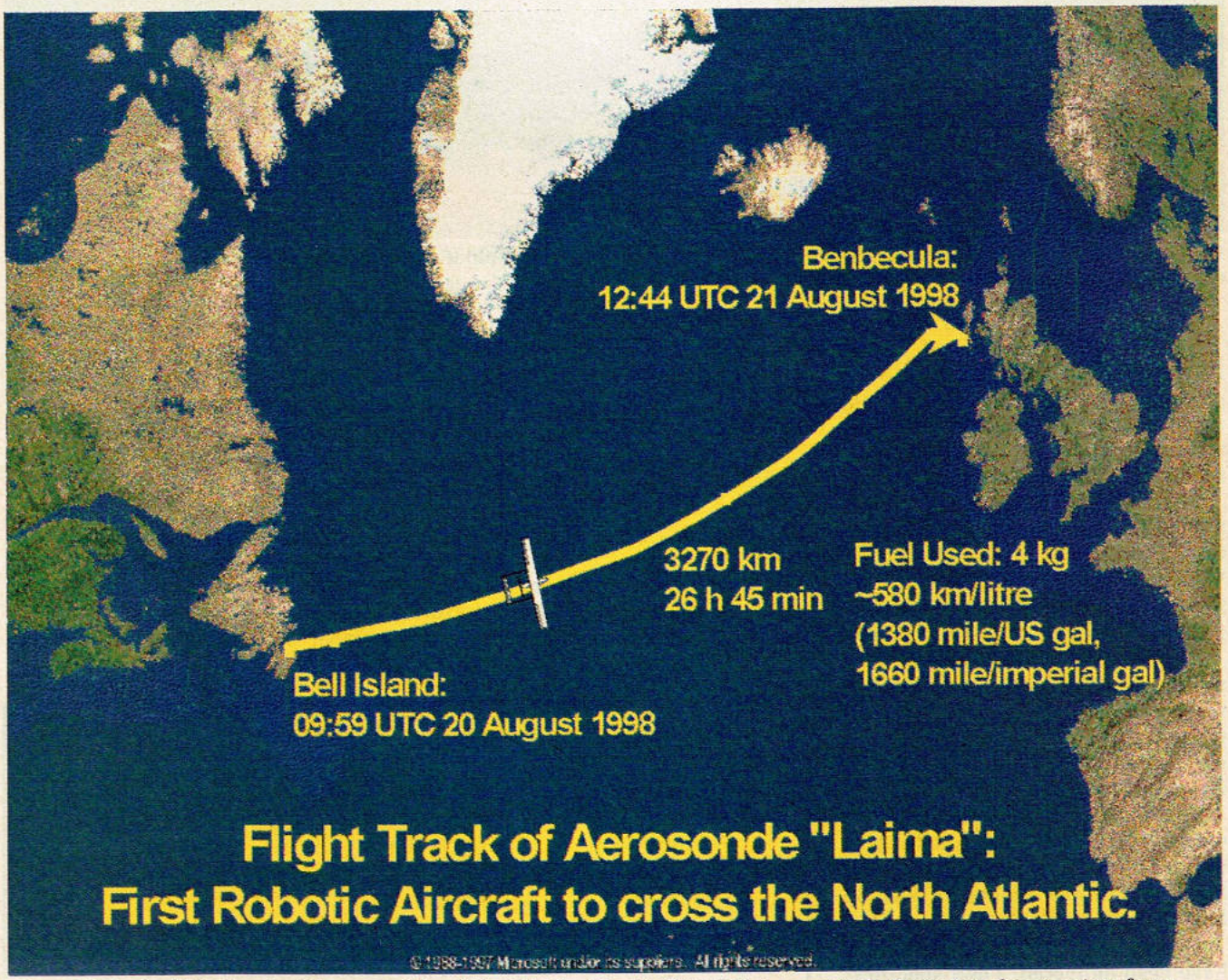

Benbecula:
12:44 UTC 21 August 1998
3270 km
26 h 45 min
Fuel Used: 4 kg
~580 km/litre
(1380 mile/US gal,
1660 mile/imperial gal)
Bell Island:
09:59 UTC 20 August 1998
Flight Track of Aerosonde "Laima":
First Robotic Aircraft to cross the North Atlantic.
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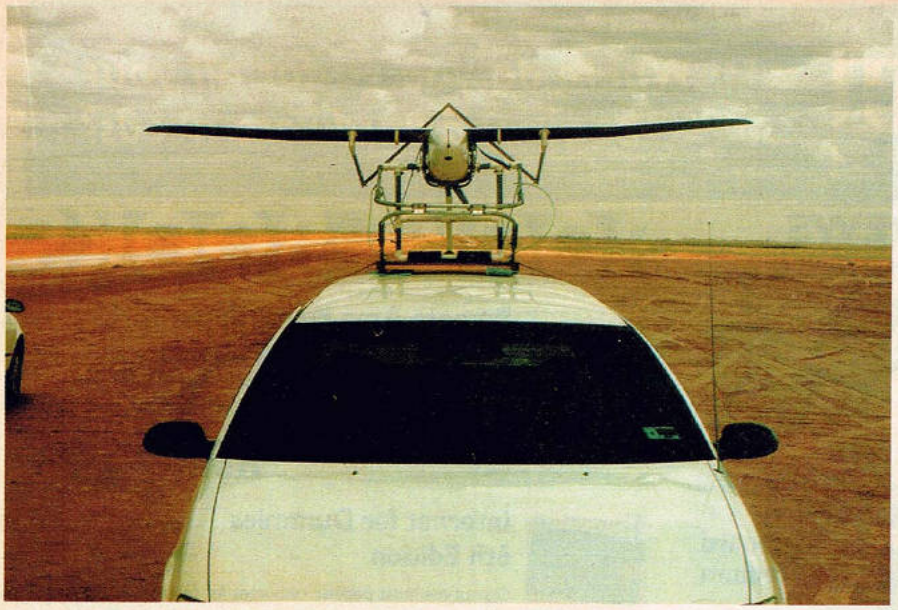
Fig.1: this is the flight track of the record-breaking North Atlantic flight. This consisted of a series of way points for a route that went slightly south of a great circle (shortest distance) to the landing site at DERA Benbecula Range in the Outer Hebrides. The altitude was specified at 1680m, dropping to around 150m on approach to Benbecula. Before launch, complete flight simulations had been made using winds provided by the US NOAA/NCEP model to provide approximate times at each way point.



The Aerosonde is normally launched from a cradle atop a car roof rack. Takeoff is normally under manual control but can be be completely automatic, as can the landing on a remote field.

had enough fuel on board for another 10 hours or so of flying.

Meteorological data were reported throughout, in conditions ranging from fair at the start to blustery, with heavy showers as a cold front moved through early on the 21st.

For us this was a milestone in not only basic performance, but also reliability and readiness for routine operations.

Several more such flights will have to be successful before we feel confident but certainly the program is steadily developing towards reliable and repeatable operations."

"1997: AUTOMATIC TAKEOFF AND LANDING - 22nd September 1997

On 22nd September 1997 an important step was taken toward automatic rather than manual control of takeoff and landing. In a one-hour test at Trout Lake in Washington, Aerosonde Millionaire flew under autopilot continuously from launch to touchdown. Figures show the landing as plotted on ground-station displays.

The aircraft touched down smoothly on the Trout Lake runway, made one small bounce and a large-angle yaw, and then decelerated rapidly through some tall clover.

Overall the performance was quite comparable to a good manual landing. Although the landing was done under autopilot, it was not quite autonomous; guidance onto the runway centreline was done visually from the ground station rather than being left to the onboard tracker.

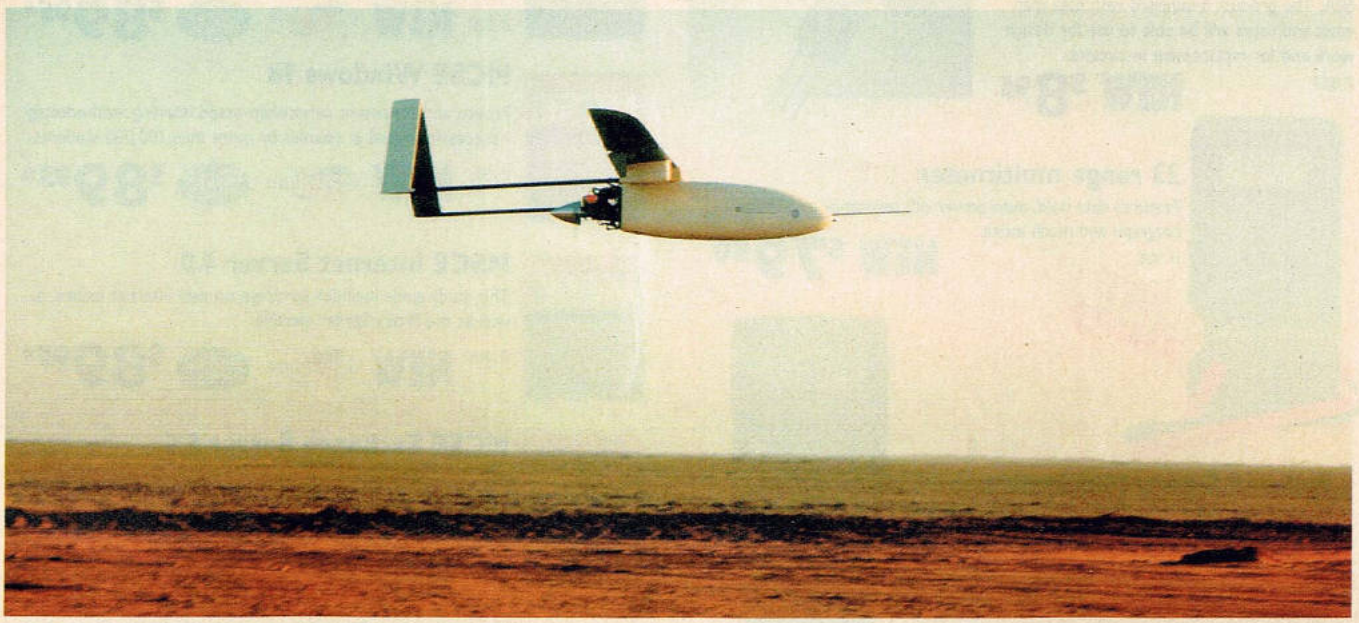
However the test produced good results in position measurement by differential GPS, so the next step to fully autonomous landing will be straightforward."

All in all the Aerosonde project is a credit to the dreamers who dared to make it happen. What an audacious project: to send a single engine, miniature aircraft across one of the most hostile stretches of ocean in the world.

Once again we see vividly demonstrated, that by standing on the shoulders of giants, we can see past the crowds who would otherwise limit our vision.

Where will this all lead? The developers envisage a global robotic airline operating out of Australia with a distributed set of launch and recovery sites ("airports" if you like) and a global command site possibly located in Melbourne. **SC**

Acknowledgement:
Much of the material in this article courtesy of Aerosonde Robotic Aircraft Pty Ltd. For more information, visit their website, www.aerosonde.com.au



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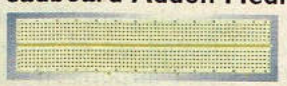

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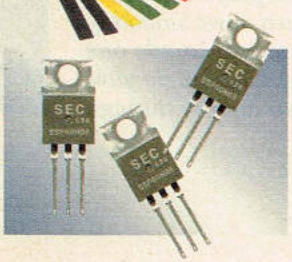

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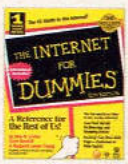

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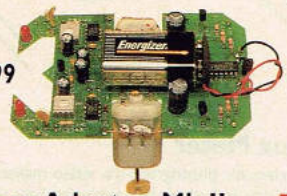

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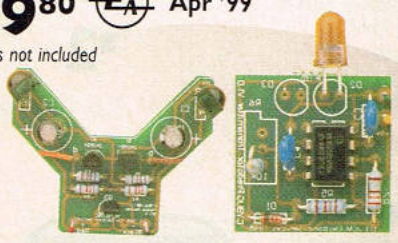

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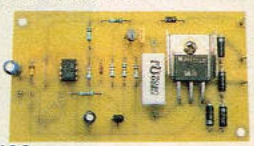

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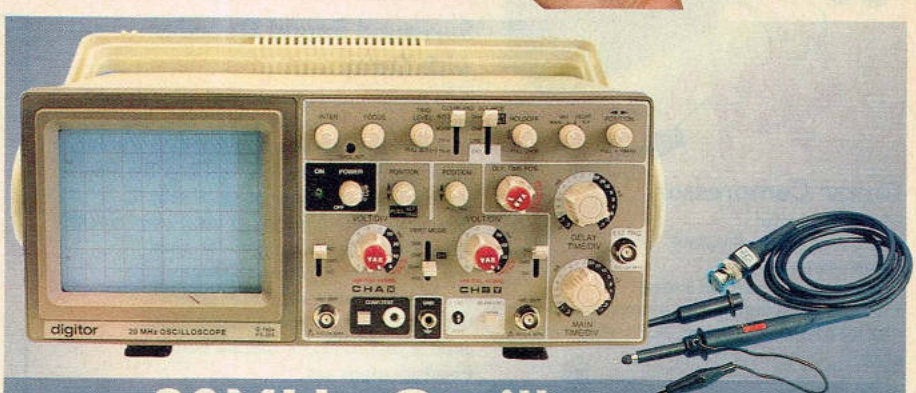

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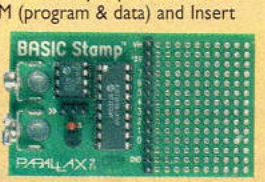

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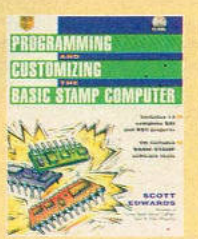

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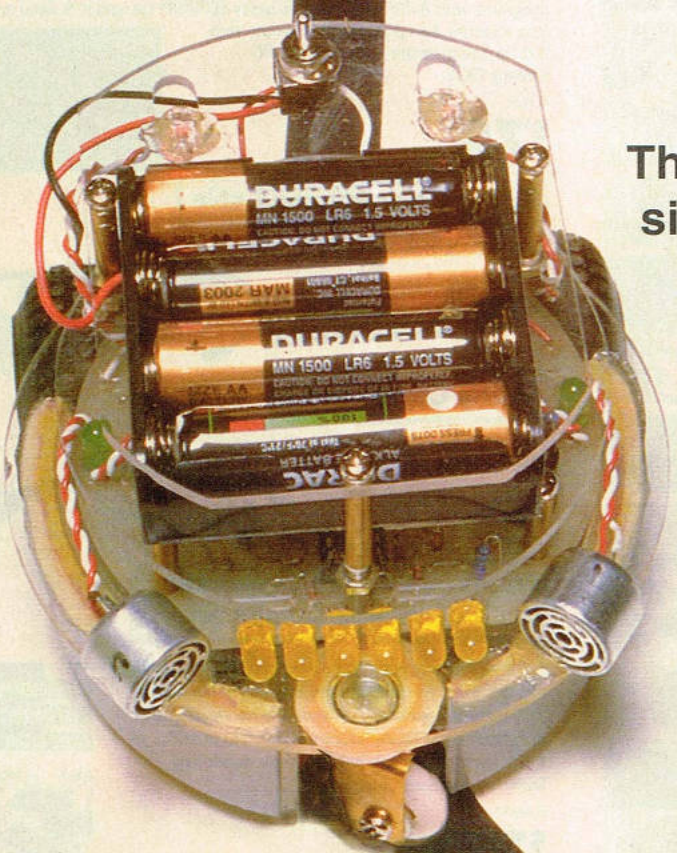
Here's A Great School or Club Project:

The Line Dancer



This cute little robot is quite single-minded: it will follow a black line on a white surface and if it meets an obstruction it will come to a stop. And to add visual interest, it has a six-LED "scanner" which flashes back and forth and a two-LED flasher as well. Best of all, it uses simple electronics and readily available mechanical parts.

By ANDERSSON NGUYEN

Powered by four AA batteries, the Line Dancer is an ideal high school electronics or industrial arts project, giving experience in Perspex work, metal work, electronics soldering, construction and even printed circuit manufacture if desired.

The Line Dancer is roughly cylindrical in shape and has three wheels, two at the back to drive it and a trailing castor at the front to allow it to go around corners. Above the drive system is the circular PC board carrying the electronics and above that again is the battery holder.

The two driving wheels are individually driven by miniature motor/gearbox assemblies. The collision avoidance system uses ultrasonic transducers which are driven at 40kHz.

Fig.1 shows the simplicity of the circuit driving the Line Dancer. The line sensing circuit works on the principle of reflected light. There are two motors, one for each rear wheel and each is controlled by its own light-sensing circuit.

So let's look at the right motor and its sensor circuit first. When its sensor, photodiode D14, is positioned over a white (light-reflecting) background, it picks up light from the high intensity LED7 and this causes D14 to conduct.

Note that the photodiode (D14) is of a type used in IR remote controls but without the IR filters and it reacts to white light. As you can see, the photodiode is reverse-biased and in the absence of light, it is non-conducting. When it picks up light from LED7, it conducts and so the voltage at the base of Q3 drops to around 0.3V or less, which turns off Q3.

Therefore the collector of Q3 and pin 8 of NAND gate IC4c is high. Assuming for a moment that the other input (pin 9) to IC4c is also high, pin 10 of IC4c will be low and this will cause transistor Q2 to conduct and drive the right motor.

The circuitry for the left drive motor, involving LED8, photodiode D15 and transistors Q4 & Q5, together with NAND gate IC4b, works in exactly the same way.

The sensors and their respective illuminating LEDs are mounted on either side of the robot and hence are on either side of the black line. Supposing that the robot is "on track", that is the black line is essentially in the middle, then both sensors receive reflected light from the light background and so both motors are running and the Line Dancer crawls forward.

Now, when the robot encounters a curve in the black track, or deviates to one side (as it will inevitably do, particularly on long stretches of straight track) as a result of unequal motor speeds, one of the LEDs will cut onto the track, reducing its reflection. The photodiode sensor then stops conducting, becomes effectively a high resistance and the associated transistor (Q3 or Q5) switches on.

As a result, the input to its respective NAND gate becomes low and the motor drive transistor switches off and its motor stops.

Since the opposite motor continues to move forward, the robot is forced to rotate to the opposite side, taking the turned-off photodiode away from the black track whereby both motors can run again.

When turning 90° around a curve, this process usually occurs several times, depending on the radius of curvature. On long straight stretches, the robot will tend to zigzag a little as a result of slightly unequal motor speeds.

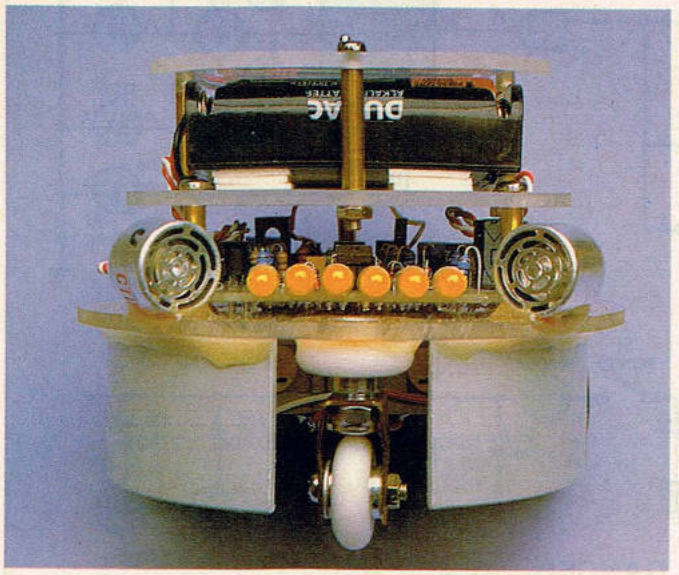
Collision avoidance

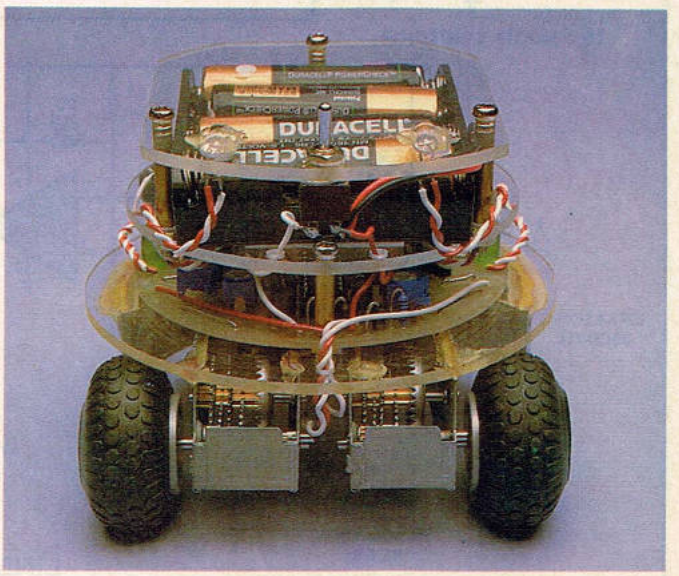
The circuit responsible for obstacle detection revolves around an ultrasonic receiver/transmitter pair. The transmitter is driven by a 555 timer operating at around 40kHz.

When the Line Dancer encounters an obstacle, the 40kHz signal from the ultrasonic transducer is reflected by the obstacle to the ultrasonic receiver.

Its output signal is amplified by transistor Q1 which drives a diode pump circuit consisting of diodes D10 & D11 and capacitors C3 & C4.

The resulting DC signal across C4 is fed to op amp IC2 which is connected as a Schmitt trigger. The Schmitt trigger's switching thresholds are set by resistors R4 & R8 and so if the DC voltage at pin 2 is a few volts or more, the output at pin 6 will switch low,





Front (above) and rear (right) views of the Line Dancer. Only the rear wheels are driven, their drive proportional to the amount of light reflected from the underneath surface. If one photodiode detects more light than its partner it says "Hey! I'm going off course" and applies more power to its motor, bringing the Line Dancer back onto the black line.

pulling low pins 6, 9, 12 & 13 of IC4, the NAND gate package. This disables gates IC4b & IC4c, stopping the drive to both motors. It also drives IC4d which is connected as an inverter and this pulls pin 13 of IC1 high, stopping it from operating.

LED scanner

IC1 is a 4017 decade counter wired as a 6-LED scanner. Its clock signal is provided by IC4a, the remaining 2-input NAND gate, which is wired as a Schmitt trigger oscillator running at about 10Hz. It clocks IC1 which counts up to 10 in the normal way, with each of its 10 outputs going high in succession.

LED1 and LED6 are wired directly to the "0" and "5" outputs respectively but LEDs 5, 4, 3 & 2 are each wired via a pair of diodes to two respective outputs of IC1.

This results in the LED array flashing back and forth to give the "scanning" effect as IC1 counts from 0 to 9.

Three diodes in the circuit remain to be mentioned. D12 and D13 serve to decrease voltage to the motors because they are nominally rated at 4.5V, while diode D9 is connected in series with the positive supply lead from the 6V battery pack. It provides protection against a wrongly wired battery.

Two flashing LEDs complete the pic-

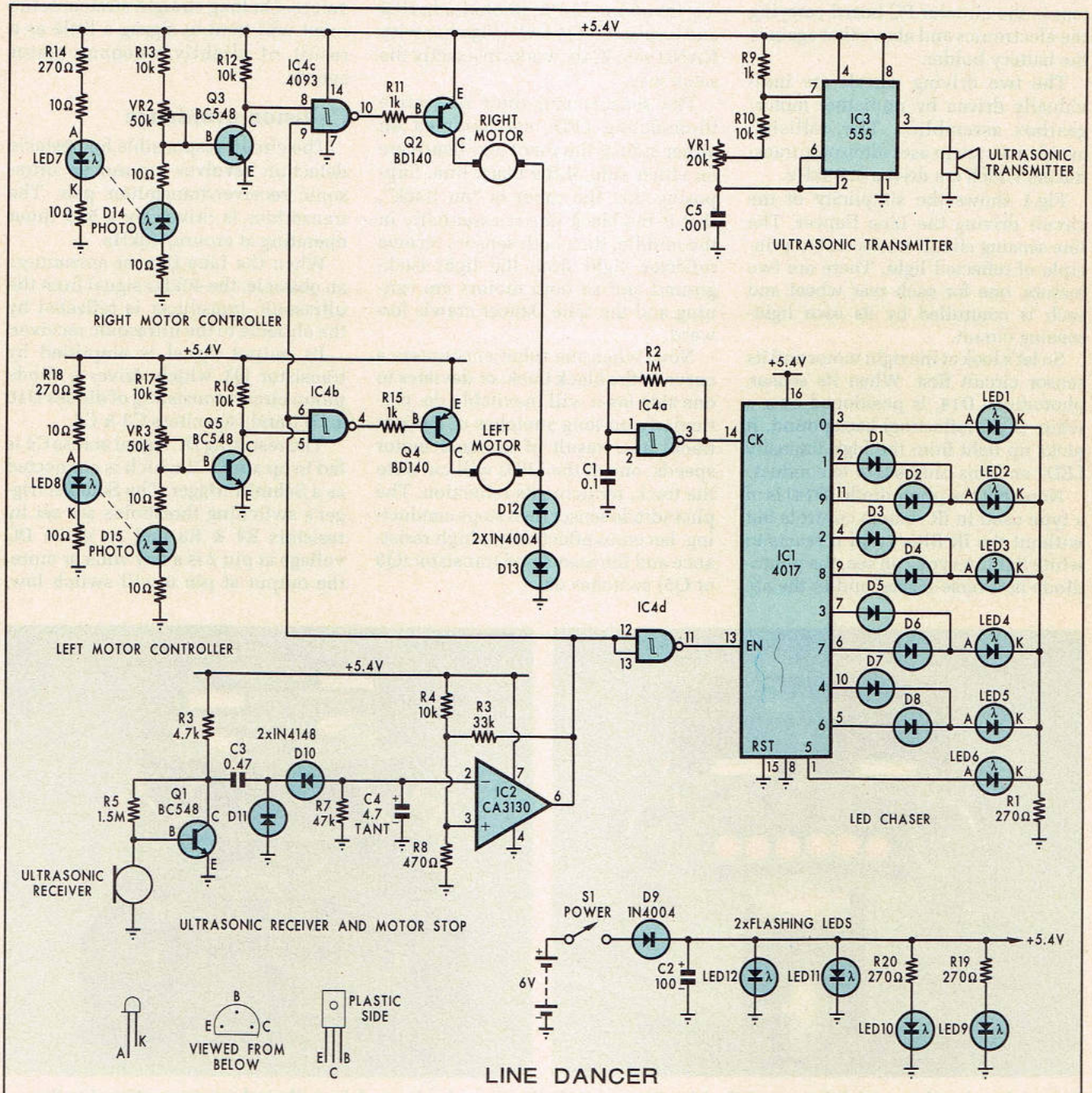


Fig.1: the motor drive system for this robot is simple. Provided photodiode D14 picks up reflected light from LED7, Q2 drives the right motor. The same applies to photodiode D15 and LED8 which control Q4 and the left motor.

ture and they are connected directly across the +5.4V rail.

Construction

This is a real hands-on project and you will need to make a lot of the parts yourself. For this reason, we have included quite a few diagrams and photographs showing how the Line Dancer is put together.

Let's begin with the PC board assembly. The component overlay for the PC board is shown in Fig.2. Check the board carefully for broken or shorted tracks and undrilled holes before you start inserting components.

Mount the wire links, resistors and diodes first, followed by the capacitors and transistors.

Next, mount the ICs, remembering the CMOS items (IC1,IC3) are static sensitive. Their positive and negative pins should be soldered first, followed by the others.

Watch the orientation of the scanner LEDs. They are not all oriented the same way. LEDs 7 & 8 and photodiodes D14 & D15 are mounted on the underside of the PC board with the tip of each LED/photodiode pair being 32mm from the underside of the PC board, as shown in cross-sectional diagram, Fig.3.

Now they are not likely to be supplied with sufficiently long leads to achieve this so you will need to extend them. You can do this for each LED and photodiode by connecting each lead via a 10Ω or similar low value resistor and this can be seen in the photos of the prototype.

LED9 and LED10 are used to illuminate the top Perspex sheet in the robot assembly and should be installed later, along with the ultrasonic receiver and transmitter transducers.

100mm lengths of miniature hookup should be soldered to the PC board for the ultrasonic transducers, LEDs, motors and battery supply.

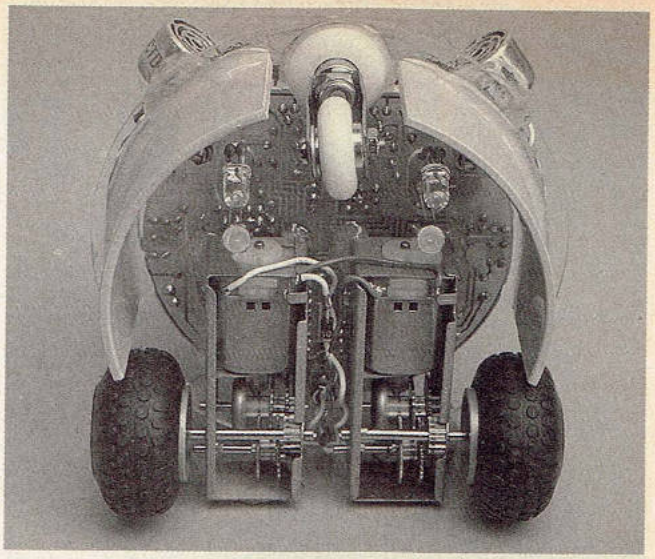
Initial checks

With the board complete, connect the ultrasonic transducers and angle them as shown in the photos.

Connect a 6V battery pack or DC supply and check the voltages around the circuit. You should be able to measure +5.4V at pin 16 of IC1, pin 7 of IC2, pins 4 & 8 of IC3, pin 14 of IC4 and at the emitters of Q2 and Q4.

If you have an oscilloscope or frequency meter, connect it to pin 3 of IC3 and adjust trimpot VR1 to obtain a frequency of 40kHz.

If these test instruments are not available, the circuit is adjusted for best operation by "feel"; ie, adjust trimpot VR1 so that the LED scanner stops when your hand is brought within about 50 or 60mm from the ultrasonic transducers. Trimpots VR2 & VR3 should be adjusted to have a resistance of about 45kΩ.



Look, mum, a wheelie! Maybe the Line Dancer hasn't quite got enough power to stand on end – but if it could, this is what you would see. What you *don't* see in this pic are the sleeves shielding the two photodiodes – these have been removed for clarity.

Motor gearbox assembly

The two motor and gearbox assemblies can be purchased ready-assembled from any Jaycar Electronics store (Cat. YG-2725). These are a relatively cheap variety of gearbox but any other hobby motor/gearbox which runs on 3-4.5V will suffice. An appropriate speed reduction ratio should be selected.

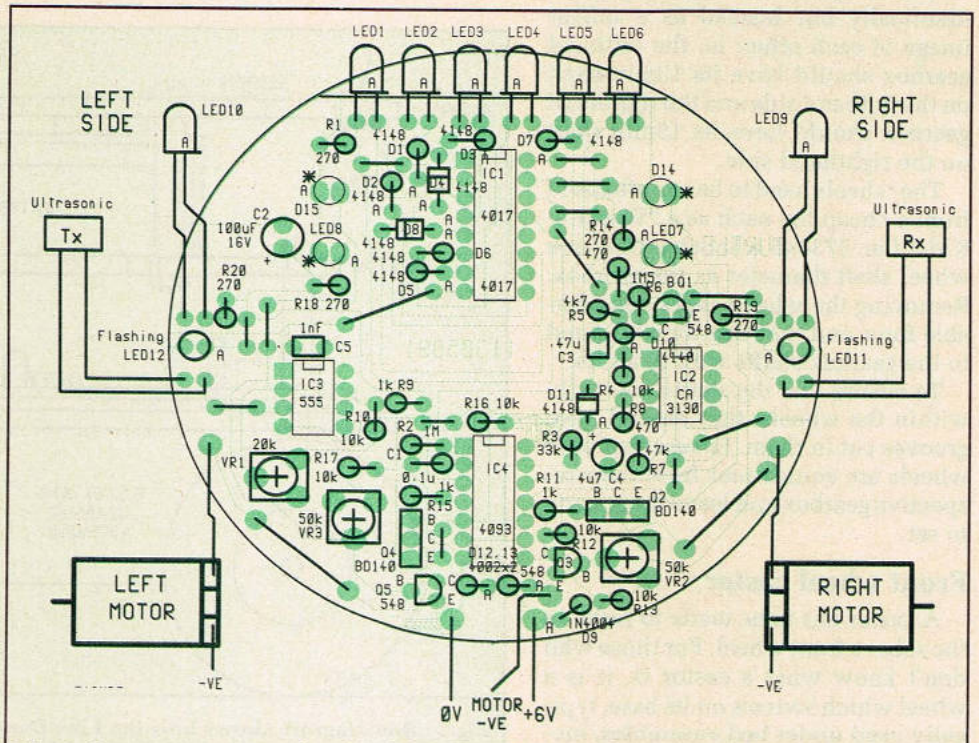
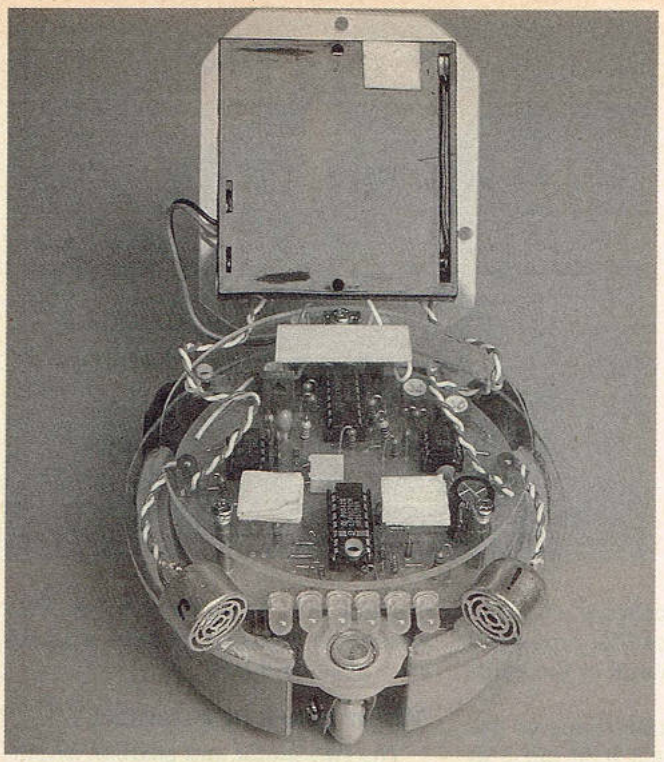
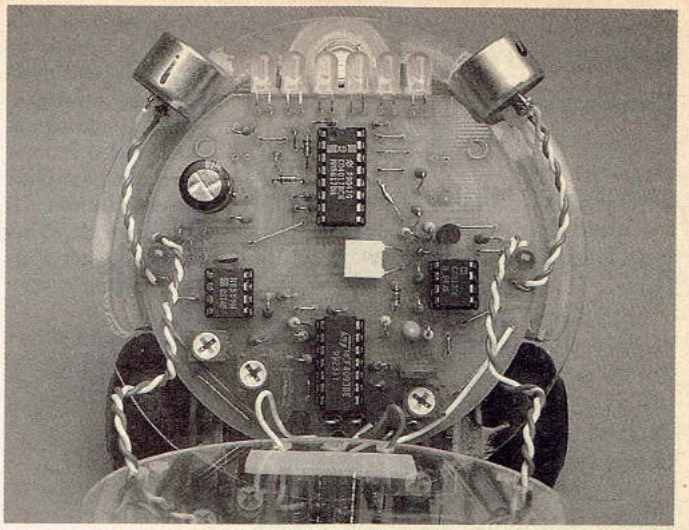


Fig.2: the component overlay for the PC board. Note that LEDs7 & 8 and photodiodes D14 & D15 are connected to the board via 10Ω resistors in each leg. (See text).





These two photos, from front and back, show Line Dancer with the battery pack and acrylic plate "1" removed (left) and the acrylic plate "2" removed (above). These will assist both PC board assembly and final construction.

The Jaycar gearboxes have long shafts on both sides and these need to be cut to the required length. This is done by clamping the shafts in a vice.

For each gearbox, one side is cut to within 2mm of the gearbox, the other cut to protrude 15mm.

The two gearboxes must **not** be cut identically but instead as a mirror image of each other; ie, the lefthand gearbox should have its 15mm shaft on the lefthand side and the righthand gearbox should have its 15mm shaft on the righthand side.

The wheels need to be cannibalised from a cheap toy such as a "World-4-Kids" Cat. 373845 which has the same wheel shaft diameter as the gearbox. Removing the wheels takes considerable force and they can then be glued to the gearbox shafts with Araldite.

To ensure that the shafts don't slip within the wheels, they should have grooves cut in them. Ensure that both wheels are equidistant from their respective gearbox and leave them aside to set.

Front wheel castor

A castor has to be made to serve as the robot's front wheel. For those who don't know what a castor is, it is a wheel which swivels on its base, typically used under bed ensembles, mobile cabinets and other furniture.

The only problem is finding one small enough to suit the Line Dancer. You can't!

Plainly, the only approach is to build your own. In the prototype, this was made from two sliding door roller wheels, 20mm in diameter, available at hardware stores.

Both are ball bearing type, one of which comes complete with a threaded shaft on one side with matching nut. The other simply has a through hole for a shaft.

A wheel bracket can be made using sheet aluminium or a strip of brass (see Fig.4). The bracket was then attached to the first roller wheel and secured with the nut. The second roller wheel forms the actual front wheel and was secured to the bracket using a bolt, nut and some washers.

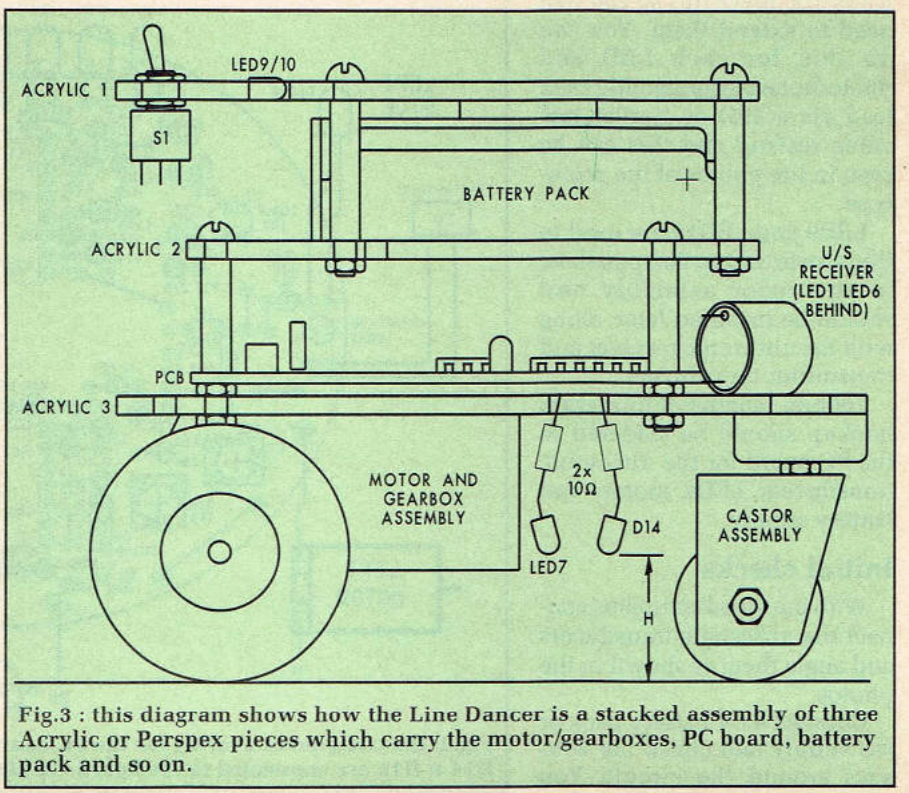
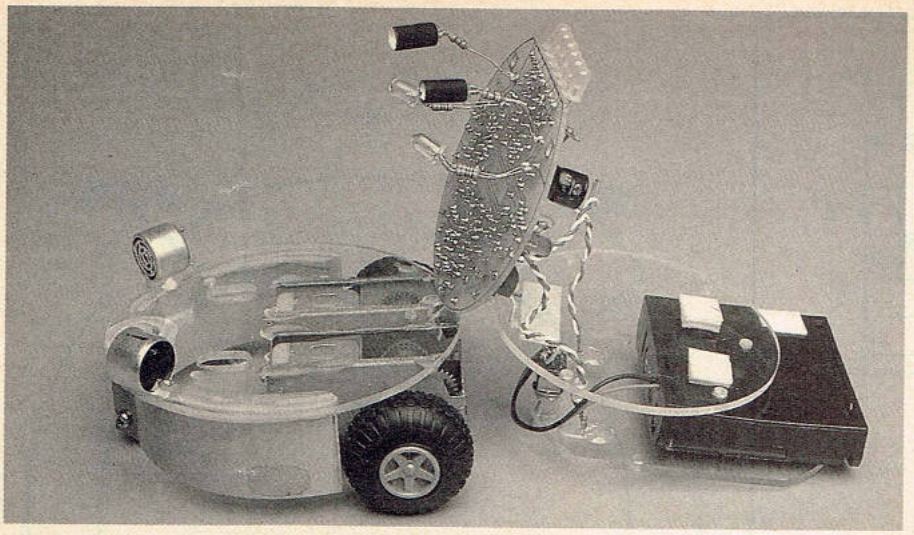
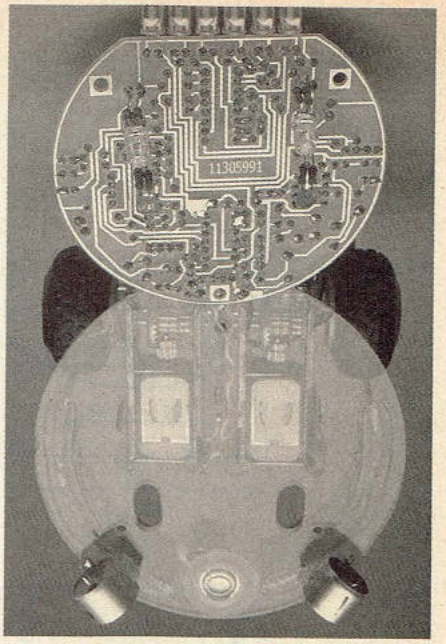


Fig.3 : this diagram shows how the Line Dancer is a stacked assembly of three Acrylic or Perspex pieces which carry the motor/gearboxes, PC board, battery pack and so on.





Here is the Line Dancer fully "opened up", showing how the motors and ultrasonic transducers are attached to plate "3". The holes in the plate are for the sensor photodiodes and LEDs to poke through. Note (above) the small tube shields slipped over the photodiodes (removed in right photo).

The bracket is fixed to the swivel bearing slightly off-centre with a nut and screw through the hole in the bracket. The drawing of Fig.4 is only meant as an example and you may construct your castor in any manner which is suitable.

Remember however, that if the wheel is not completely free to swivel, then operation may impaired.

The dimensions of the three plates (pieces of Perspex or Acrylic) for the Line Dancer assembly are shown in Fig.5. They should be roughly cut out with a bandsaw or coping saw. The pieces can then be trimmed to size with a bench disc sander. Holes should be drilled where indicated.

Deviations in the locations of holes will result in the parts not fitting together during assembly. The two elongated holes in Plate 1 are made by drilling two adjacent holes, then opening them out with a small file.

Six untapped metal spacers, three 15mm long and three 20mm, were cut from hobby brass tubing using tube cutters. If you can't get this tubing, you can always stack groups of 6mm untapped spacers to get the desired results, as these can be purchased cheaply in quantities of 100. You will need to use the spacers to stack the three Perspex plates as shown in Fig.3.

The gearbox/motor/wheel assemblies are glued to the largest of the Perspex pieces (Plate 3) using contact adhesive. The front wheel is similarly attached, being extra careful not to get glue into the rotating components.

The PC board is fixed to the second Perspex sheet (Plate 2) using the 15mm spacers and 32mm screws and nuts. This is then attached to the third Perspex sheet, threading the photodiodes and LEDs through the holes. Nuts on the underside are used to hold these pieces in place. The nut which is to go in between the two motors will require a steady hand and a pair of tweezers.

The ultrasonic receiver and transmitter are glued at the front of Plate 3, on either side of the LED scanner. They are positioned at an angle of approximately 80° to each other, as shown in Fig.6.

Glue LED19 & LED20 to Plate 1 in the elongated holes. The wires from the PC board can now be connected to these, along with the motors and ultrasonic transducers.

A switch (S1) is mounted on Plate 1 and power connections to the battery holder are made via this switch.

The battery holder is attached to Plate 2 with double-sided tape.

A piece of tubing 8mm long is fitted over each of the photodiodes, which are hanging down from the underside of the PC board. The tubing helps to limit the effect of extraneous light. The LEDs and photodiodes are then bent to the appropriate angle with respect to each other to optimise the

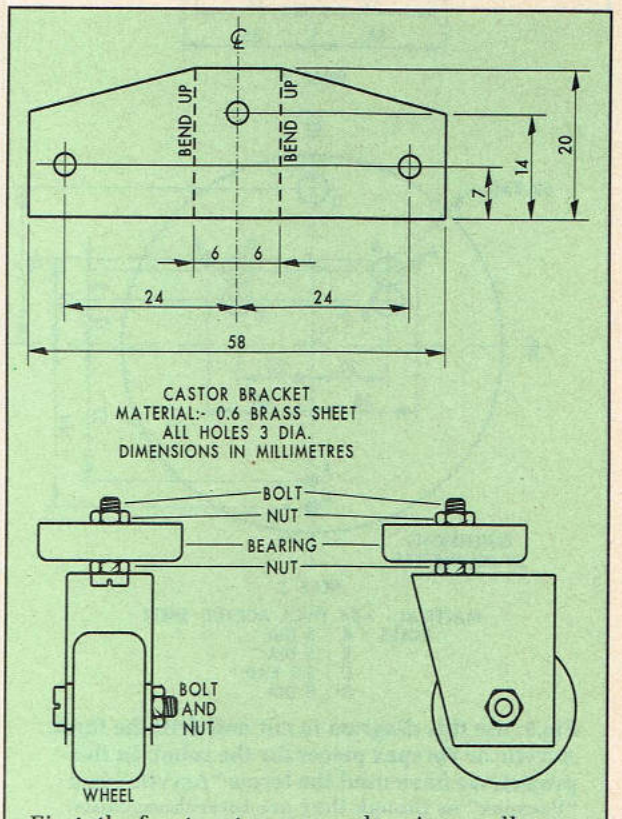


Fig.4: the front castor was made using small wheels from a sliding door roller set, available from hardware stores.

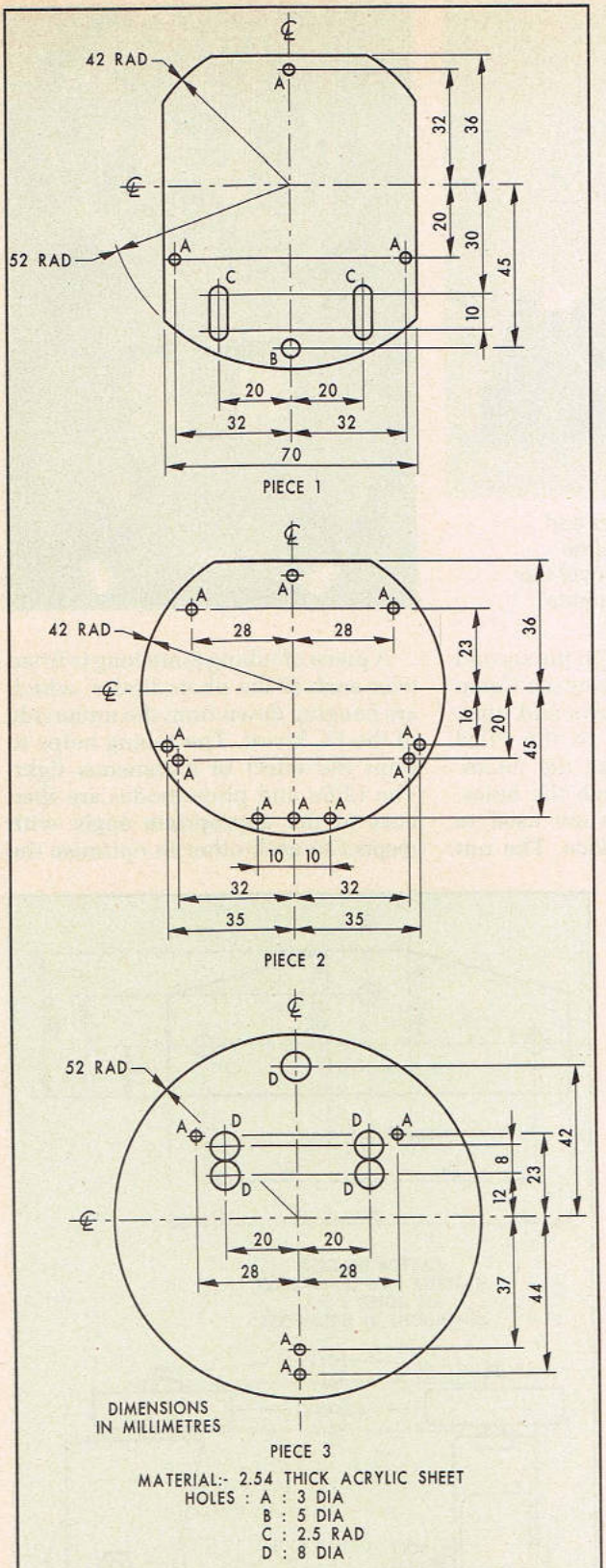


Fig.5: use this diagram to cut and drill the three Acrylic or Perspex pieces for the robot. In this project, we have used the terms "Acrylic" and "Perspex" as though they are interchangeable. While different products, either can be used for the Line Dancer (as could some other plastics).

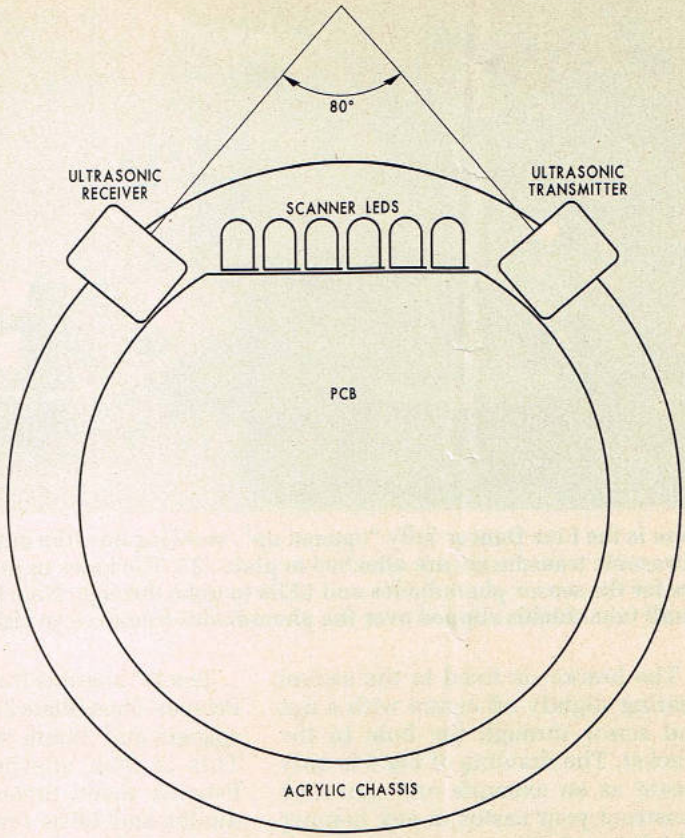


Fig.6: the ultrasonic transducers should be positioned at an angle of 80° to ensure that the collision avoidance system works.

reflection of light into the sensors. Remember the basic rule of optics: Incident angle = Reflected angle.

To further shield the photodiodes from ambient light, you need to fit a plastic skirt to the underside of the base plate of Perspex. This can be fashioned from a couple of pieces of 80mm diameter PVC pipe and then glued to the Perspex piece. Alternatively, you could use a 90mm PVC end cap, instead of making the skirt and the bottom Perspex piece. Note that the skirt should have about 5mm of clearance above the table top or working surface.

Before operation, tidy up all your wiring. You will need to mark out a large circular or roughly rectangular track using plain black electrical insulating tape on a smooth, light surface, preferably a white floor or large table.

The radius of curvature of the track should not be less than 30cm and rightangle turns are not negotiable.

Troubleshooting

All things being equal, the Line Dancer should function well. However, under certain circumstances it may not behave as it should. For example, if the Line Dancer is initially adjusted to operate in a relatively poorly lit room and then operated in a brightly lit room, it may well cut across the tracks and wander off into oblivion. Trimpots VR2 or VR3 should then be adjusted to compensate for the brighter lighting conditions.

If you attempt to use the Line Dancer in sunlight, it will probably not work reliably. It's really an indoor creature and it misbehaves in intense lighting.

The use of modulated infrared LEDs and IR sensors, along the lines of the Infrared Sentry project published in last month's

Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	1.5MΩ	brown green green brown	brown green black yellow brown
1	1MΩ	brown black green brown	brown black black yellow brown
1	47kΩ	yellow violet orange brown	yellow violet black red brown
1	33kΩ	orange orange orange brown	orange orange black red brown
6	10kΩ	brown black orange brown	brown black black red brown
1	4.7kΩ	yellow violet red brown	yellow violet black brown brown
3	1kΩ	brown black red brown	brown black black brown brown
1	470Ω	yellow violet brown brown	yellow violet black black brown
5	270Ω	red violet brown brown	red violet black black brown
4	10Ω	brown black black brown	brown black black gold brown

Parts List

1 Line Dancer PC board, code 11385991
1 SPDT miniature toggle switch
4 AA cells
1 4 AA-cell holder
2 gearbox/motors, Jaycar YG-2725 or equivalent
2 wheels from toy car to match gearboxes (World-4-Kids 373845)
1 miniature castor (see text and Fig.4)
3 20mm untapped spacers
3 15mm untapped spacers (see text)
6 3mm x 32mm screws
9 3mm nuts
1 piece light gauge aluminium or brass strip, 12mm x 50mm
1 clear Acrylic or Perspex sheet, 30 x 11cm
2 pieces plastic tubing, 10mm x 5mm ID

Semiconductors
1 4017 counter (IC1)
1 CA3130 op amp (IC2)
1 555 timer (IC3)
1 4093 quad 2-input NAND Schmitt trigger (IC4)
3 BC548 NPN transistors (Q1,Q3,Q5)
2 BD140 PNP transistors (Q2,Q4)
10 1N4148, 1N914 diodes (D1-8,D10,11)
3 1N4004 diodes (D9,D12,D13)
6 yellow high brightness LEDs (LED1-6)
4 1000mCd red LEDs (LED7-10)
2 green flashing LEDs (LED11,12)
2 IR photodiodes (D14,D15)(Jaycar ZD-1950 or equiv)
1 ultrasonic transmitter/receiver pair
(Dick Smith Electronics L-7055 or equivalent)

Resistors (0.25W, 1%)

1 1.5MΩ	1 1MΩ	1 47kΩ	1 33kΩ	6 10kΩ
1 4.7kΩ	3 1kΩ	1 470Ω	5 270Ω	4 10Ω

1 20kΩ trimpot (VR1)
2 50kΩ trimpots (VR2,VR3)

Capacitors
1 100µF PC electrolytic
1 4.7µF tantalum electrolytic
1 0.47µF MKT polyester or monolithic
1 0.1µF MKT polyester or monolithic
1 .001µF ceramic

Miscellaneous
Araldite adhesive, tinned copper wire, hookup wire, solder etc.

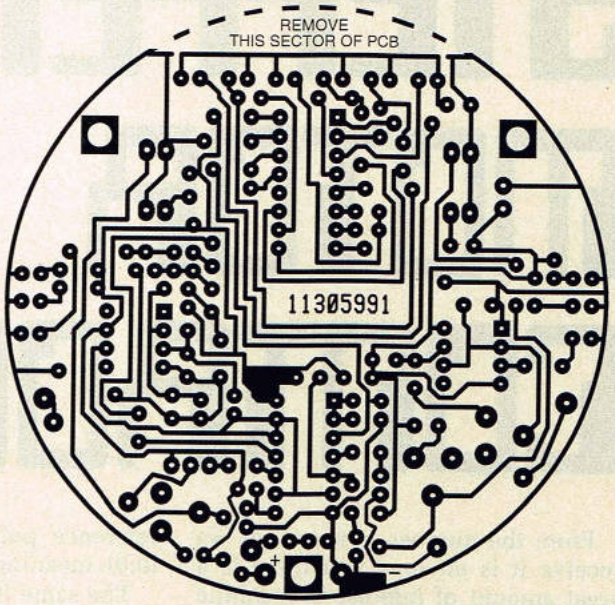


Fig.7: actual size artwork for the PC board.

issue, would have alleviated this problem but it would have made this circuit a lot more complicated.

If the Line Dancer cuts across the track only at certain places, check the amount of light from other sources falling on those areas. Also check that the track curvature is not too sharp and check that both VR2 and VR3 are appropriately set. The use of one and a half tape track widths in some circumstances may help with "track cutting".

Check that the LEDs and photodiodes are within 7mm of the surface and that they are angled correctly. This is crucial to the operation and minor deviations will result in failure to follow the track.

Track cutting can further be limited by the use of an additional diode in series with the negative lead to the motors, ie; in series with diodes D12 & D13. This reduces the motor voltage and speed, and the reduced momentum means that there is less likelihood of the Line Dancer running away from the black track.

If you have trouble finding a light coloured surface on which to operate the Line Dancer, the use of white insulating tape on either side of the black track will make it work. **SC**

X-Y TABLE WITH STEPPER MOTOR CONTROL

Have you been wondering how to use the stepper motor driver cards we featured in the latter stages of 1997? We had this project in mind then and though it has taken a while, it has finally come to fruition. This series of articles will show you how to assemble the hardware and software to drive an X-Y table.

PART 1: INTRODUCTION

From the number of enquiries we receive it is obvious that there is a great amount of interest in machine control. With this in mind, we have produced a practical demonstration X-Y table project using stepper motor control. It could be expanded to control a variety of processes and machines.

First of all, though, perhaps we should explain what an X-Y table is because many readers may not have come across such a device before.

Casting your mind back to school days, you will recall that a graph has two axes, the "X" axis, which is the horizontal direction, and the "Y" axis – not surprisingly, the vertical direction.

Within the confines of the graph, any point can be located from the origin by giving its coordinates in terms of plus or minus X units, and plus or minus Y units. The origin, or reference point, is normally called (0,0), meaning X=0 and Y=0.

The same logic – no pun intended (or was it?) – can be applied to locate positions away from an origin for just about anything, as long as you know the units being used. Map co-ordinates are just one example.

Suppose we want to locate a position on a solid (flat) object? Exactly the same system applies. And this is the basis for the X-Y table.

We lock the object – a piece of paper for drawing on, a PC board to be drilled, a piece of metal to be engraved – in position, and by either moving the object with respect to a fixed point, or moving something else with respect to the fixed object, we can move a pen, a drill, an engraving head, you name it, to an exact spot by giving it the X-Y coordinates.

In this case, we cheat a little and place our origin (0,0) in the bottom left hand corner, so all points on the object are positive numbers (it just makes life easier to do it that way).

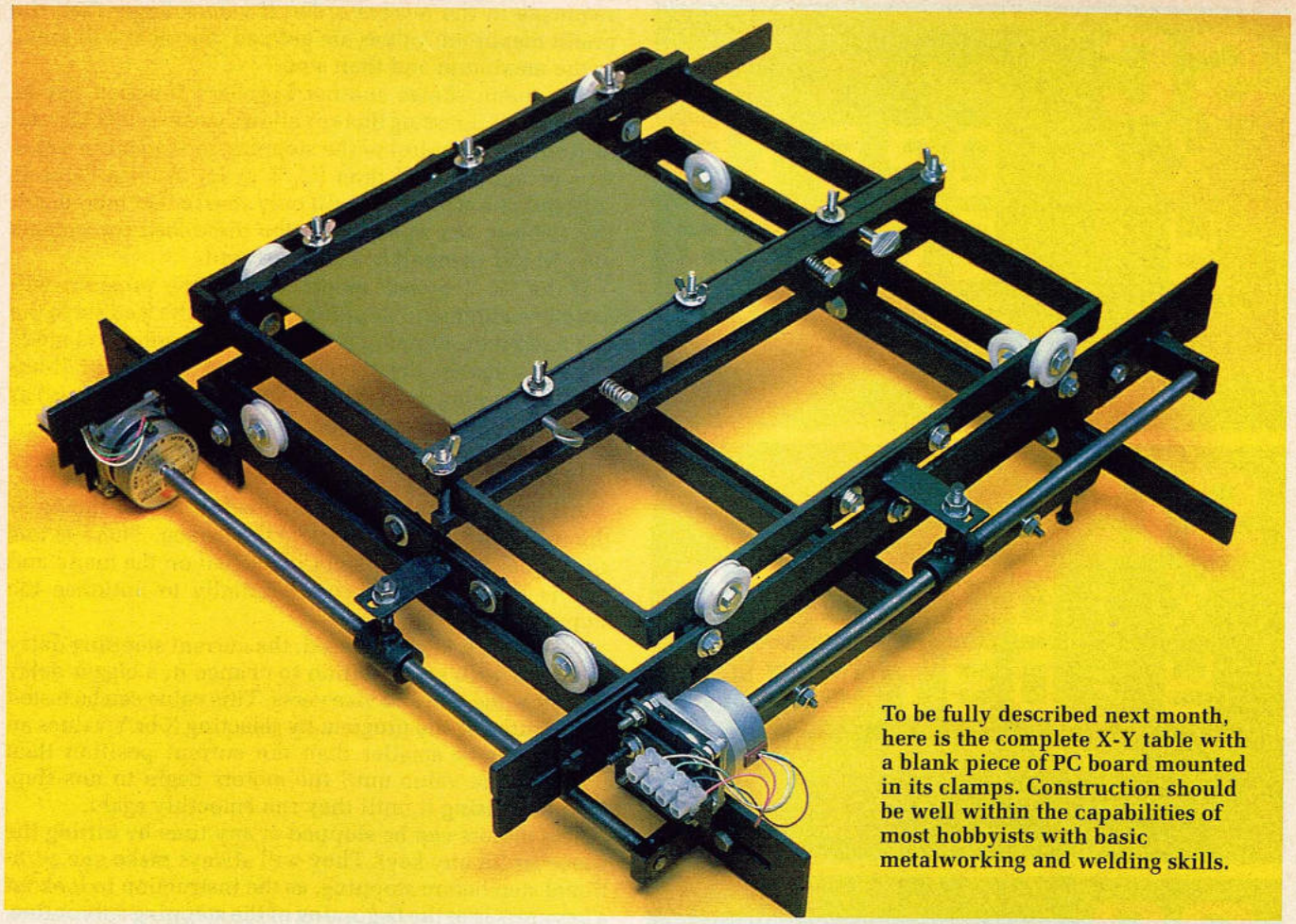
X-Y tables are commonly used in a huge variety of applications from industry through to medicine and virtually everything in between.

Our X-Y table is reasonably small by industry standards but it will be capable of doing quite large and sophisticated jobs.

In the months to come, it will be extended so that it can be used to plot and drill PC boards which have been laid out using Protel. For the moment though, let us now describe the basic X-Y table with stepper motor drive.

An IBM-style computer is used as the interface between the operator and the table. It doesn't have to be the latest whizz-bang Pentium. A 486 or even a 386 will work quite well as long as it has a VGA graphics card fitted. While the slower processors

Mechanical Design & Construction by Ken Ferguson
Electronics by Rick Walters



To be fully described next month, here is the complete X-Y table with a blank piece of PC board mounted in its clamps. Construction should be well within the capabilities of most hobbyists with basic metalworking and welding skills.

will take a little longer to run a task, the stepping speed of the motors will be the limiting factor.

Most programs, although written in GW Basic, are supplied as an EXE as well as a BAS file. The BAS file will allow you to readily make any changes to the software that you may deem necessary.

The computer controls the dual stepper motor driver card, featured in the September 1997 issue of SILICON CHIP. The +5V and +12V supplies for this card can be picked up from an internal disc drive power connector or from an external power supply.

The stepper motors we have used are 12V 1.8° types which with the hardware used, make four steps for a table movement of one thousandth of an inch (.001"). In some respects this is too fine, as it takes a while to traverse from zero to maximum but with the limited availability of threaded rods, this proved to be the optimum choice.

Although Australia is a metric country, Imperial measurements were chosen as most PC board components are still laid out on an Imperial grid (ie, 100ths and 10ths of an inch).

The outline of the table measures 750mm x 700mm and the X and Y axes can each traverse 300mm.

Software details

We shall describe the software first before we go onto the mechanical side, as this will be your interface while operating the table.

The control screen is shown in Fig.1. This is the only screen for XYTABLE.BAS or XYTABLE.EXE and shows the current X and Y position of the table, along with a menu across the bottom of the screen.

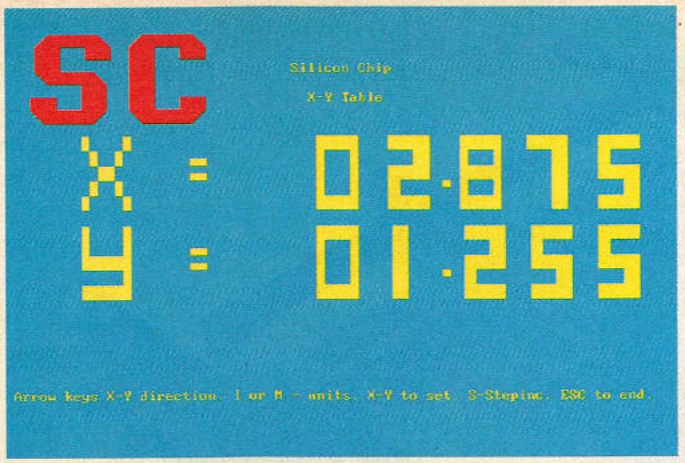
"Arrow keys X-Y direction" indicates that the four arrow keys on the keyboard are used to move the table in the X and Y directions. The right arrow and up arrow keys increase the X and Y position, while the left arrow and down arrow keys reduce it.

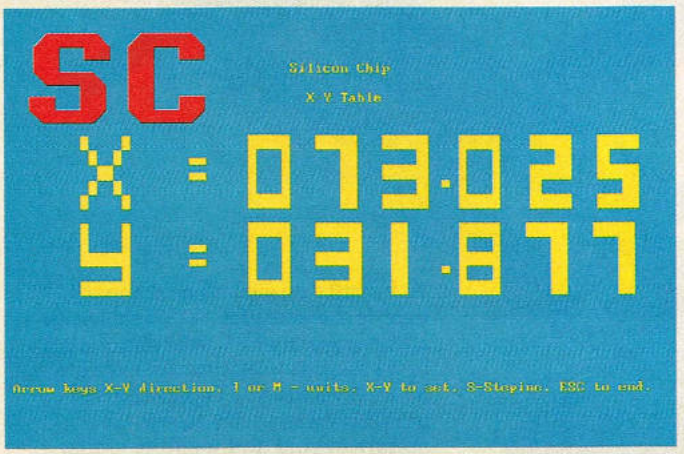
The next menu entry is "I or M - units". These keys select either an Imperial or Metric screen display of the current X and Y position. The metric display (Fig.2) is just a mathematical conversion of the inch value. If the Metric display is selected, then the X and/or Y co-ordinate is changed and the table will only move to the closest converted Imperial measurement.

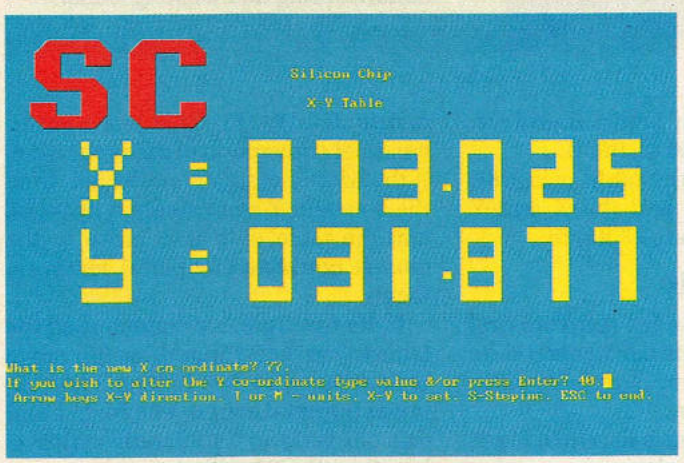
If, for example, we commanded the table to move to 25mm it would move to 25.018mm or .985 inches. The next lower imperial step is .984 inches and this converts to 24.994mm which is less than the 25 called up.

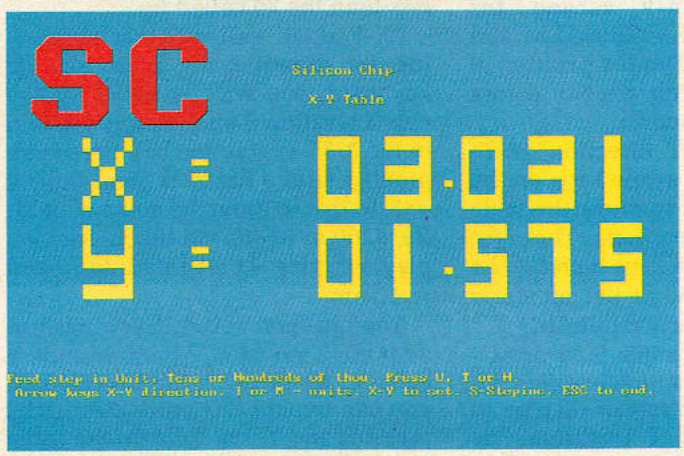
"X-Y to set" indicates that by pressing, for example, the X key on the keyboard, you will be asked for the new X position. This message is shown in Fig.3. The value can be entered as a number with a decimal point (ie, 3.2 or 3.186) or without the decimal point (ie, 3200 or 3186). On the metric display, entering 43 will be interpreted as 43mm.

You are then asked if you wish to alter the Y position. You may enter a value or by pressing the ENTER key, you can bypass this entry. Similarly, pressing the Y key follows the same






SC
Silicon Chip
X-Y Table
X = 073.025
Y = 031.877
What is the new X co-ordinate? 77.
If you wish to alter the Y co-ordinate type value &/or press Enter? 40.
Arrow keys X-Y direction. I or M - units. X-Y to set. S-Stepinc. ESC to end.


SC
Silicon Chip
X-Y Table
X = 03.031
Y = 01.575
Feed step in Unit, Tens or Hundreds of thou. Press U, T or H.
Arrow keys X-Y direction. I or M - units. X-Y to set. S-Stepinc. ESC to end.

sequence in the reverse order. If values larger than the preset maximum values are entered, the table will move to the maximum and then stop.

The menu shows another keyboard function key as "S-Stepinc". Pressing this key allows you to select Manual or Automatic control of the stepping increment in units, tens or hundreds of thou (U, T or H). After a value is selected, the arrow keys will only step in that increment. Fig.4 shows the screen with the three feed increments after M (for manual) has been pressed.

If the "X-Y to set" mode is used, the program will switch to automatic stepping and leave the feed set to the last automatic stepping increment. The automatic mode always steps in the largest possible increment (hundreds), stepping down to tens and units (if necessary) as it homes to the selected coordinate.

Stepping rate

All the functional keys described so far are shown in the menu bar at the bottom of the screen. There is one additional key which is not identified on the menu and this is the R key. It is used initially to optimise the stepping Rate.

When the R key is pressed, the current stepping delay is shown with an invitation to change it; a bigger delay will slow the rate and vice versa. This value can be tested while running the program by selecting X or Y values an inch larger or smaller than the current position then reducing the value until the motors begin to mis-step, then increasing it until they run smoothly again.

The motors can be stopped at any time by hitting the spacebar (or any key). They will always make one additional step before stopping, as the instruction to look for a keypress is at the beginning of the stepping subroutine.

There are two other keys which you may find useful. The HOME key will rapidly move the table to X=0, Y=0 when it is pressed and the END key will move the table to the maximum limits.

These limits, along with a few other parameters which will be explained later, are initially written to a disc file (XYPLOT.FIL) using a separate program (XYSETUP.BAS or XYSETUP.EXE).

We will not go into the details of the stepper card in this article. If you need more information, refer to the September 1997 issue. The card is allocated an address between 1 and 8 via a jumper on it and this allows the computer to control several cards connected in parallel to the one printer port.

The selected address of this card is also written to the disc file. This file allows you to run XYTABLE.EXE but alter the values it uses, as the compiled EXE program runs a great deal faster than the interpreted Basic.

The other parameters saved to the file are the X and Y positions each time the program is exited, the motor stepping rate, the selected measurement units and the printer port used to drive the card.

Figs. 1-4 (left): these X-Y table control screens are fully described in the text. The difference between the first and second screens is that the first is imperial and the second metric – even though Australia uses the metric system, most engineering specifications are given in imperial units.

When using this interface card, it is important that the program is loaded and run before the 12V is applied to the cards. When power is applied to the card, the outputs of IC2 may be high or low. This is a random function but if the Q0 and Q1 outputs were both high, Q1 and Q4 as well as Q2 and Q3 would be turned on, causing at least one transistor to self-destruct. The others could also be seriously damaged.

Relay modification

To overcome this problem, we have produced an add-on circuit with some extra logic and a relay to switch the +12V supply to the output transistors only after the software has set all IC2's outputs low.

The circuit for this modification is shown in Fig.5. At switch-on, both flipflops are reset by the 1MΩ resistor and the 0.1µF capacitor connected to pins 14 and 15, which means that the Q outputs are low. Thus D1 and D2 will hold the base of Q1 low and the transistor will be turned off.

When the software is run, it first sets all the IC2 outputs low then takes IC1-Y6 low and high then IC1-Y7 low and high. These outputs are normally high but again, at power-up any one output could be low. This is why we toggle two outputs (to be sure, to be sure). As each flipflop is clocked the Q output will go high. The 1kΩ resistor will now pull the base of Q1 high, which will energise RLY1 which feeds the 12V supply to the output drivers.

If you already have this card you could build the circuit up on a piece of perf board and mount it on the PC board in the vacant area adjacent to IC2.

Maximum stepping rate

The maximum motor stepping rate will vary, depending on several factors: the applied motor voltage, the motors themselves and the computer's clock speed. We need to step the motors as fast as possible but there is a problem.

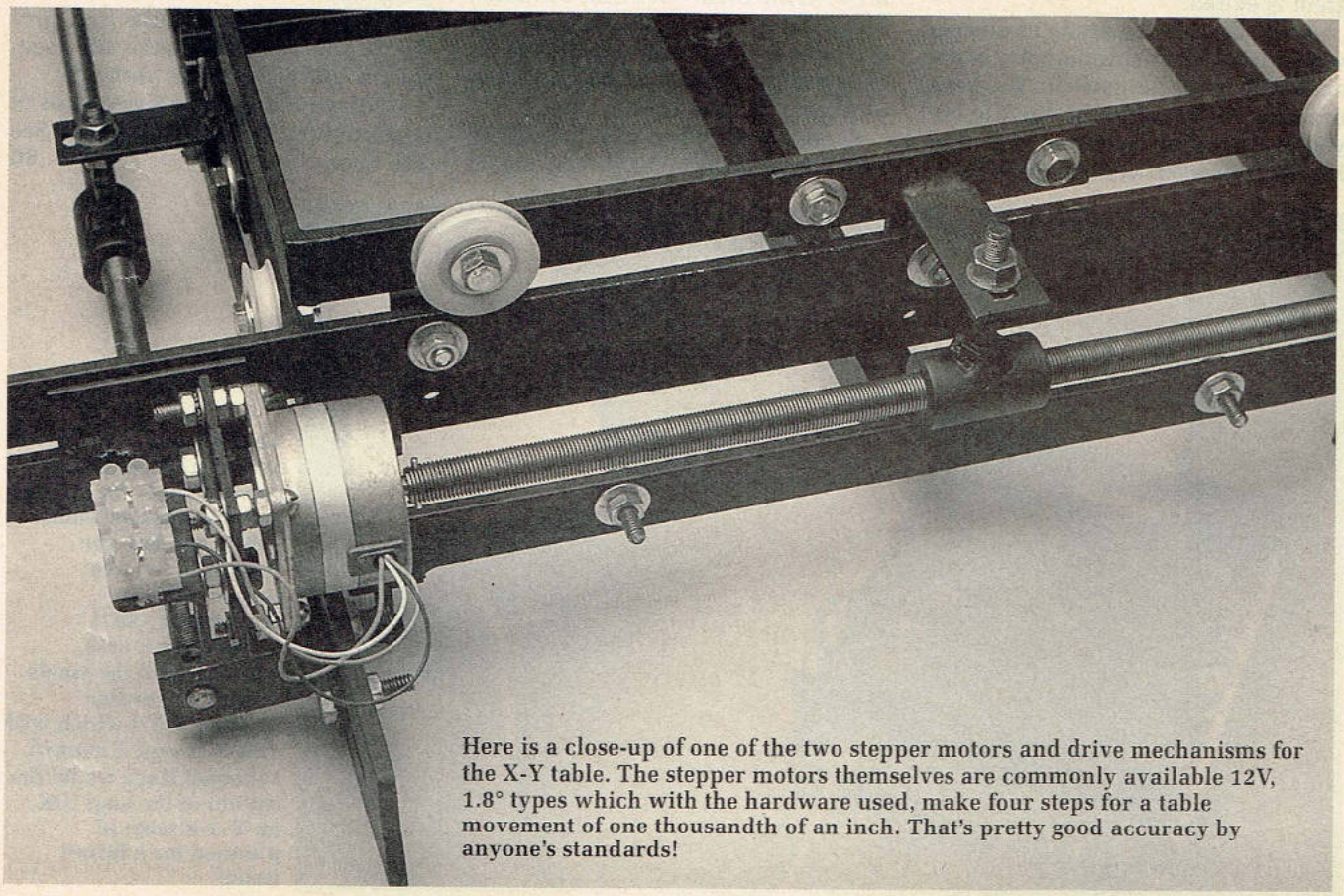
If the maximum stepping speed was set to suit a 486, then if the program was run on a Pentium, it would step the motors so quickly that they would not be able to respond and would just sit there chattering.

We found values around 190 worked well with a 386 using GW-Basic and 1950 when using the EXE file. Use these values as the starting point for faster computers. Don't contemplate running the BASIC program for anything but testing your software modifications as it is FAR TOO SLOW to be useful.

While XYTABLE is useful for manoeuvring the table and getting the feel for the system, it is not much use if you wish to move it through a sequence of positions over and over. To this end, we have produced another program called XYREAD.BAS. This is capable of reading a sequence of positions which you have tabulated and saved as a file. It has not been converted to an EXE file as you will obviously wish to modify it to add your particular requirements to it.

We have made the table move to the X-Y position it reads from the file then the computer will beep, waiting for a keypress. It will then move to the next set of co-ordinates it reads and beep.

The opening screen for this program is similar to that of Fig.1 except that instead of a menu across the bottom of the screen, you will be asked for the name of your file.



Here is a close-up of one of the two stepper motors and drive mechanisms for the X-Y table. The stepper motors themselves are commonly available 12V, 1.8° types which with the hardware used, make four steps for a table movement of one thousandth of an inch. That's pretty good accuracy by anyone's standards!

To assist you we have included a file named XYTEST.MOV which has a sequence of X-Y movements.

The file structure is based on that used by NC drills but without tooling information. It consists of an X location followed by a Y location. If either location stays the same on the next step only the new value is printed.

A brief extract of a typical file would look like this:

X04125Y008
X045
X00825Y0065
X00975
Y039

As you can see, it consists of one X-Y instruction per line. All dimensions are based on 99.999" being the maximum allowable value, although the decimal point is omitted.

Thus X04125Y008 defines X at 4.125" and Y at 0.8". If the X value was to remain the same the next entry (on the next line) could be Y00775. Trailing zeros are omitted.

Once the end of the file is reached the table is homed to 0,0. This is just a precaution in case XYPLOT.FIL is corrupted, as this file stores the last X and Y co-ordinates before the program is exited.

A file like this can easily be created with a text editor using non-document or ASCII mode to save it. We have used the MOV suffix for our file but you may choose whatever you find logical. However, you should always add a suffix, as it helps to identify or group files (DIR *.MOV), especially if you don't create a special subdirectory.

The seven files, XYREAD.BAS, XYTEST.MOV, XYTABLE.BAS, XYTABLE.EXE, XYSETUP.BAS, XYSETUP.EXE and XYPLOT.FIL are available free from our web site, or on floppy disc (price is $7.00 including p&p from SILICON CHIP).

If you don't have a subdirectory called BAS on your hard disc, create one (from c:\ type MD BAS then press Enter). Copy the seven files to this directory, and either add C:\BAS; in your path statement or change to the BAS directory (CD \BAS) to run the programs.

Naturally, if you edit the BAS programs you can change the file location in line 6030 to suit yourself.

Next month, we will give details of construction for the X-Y table. See you then. **SC**

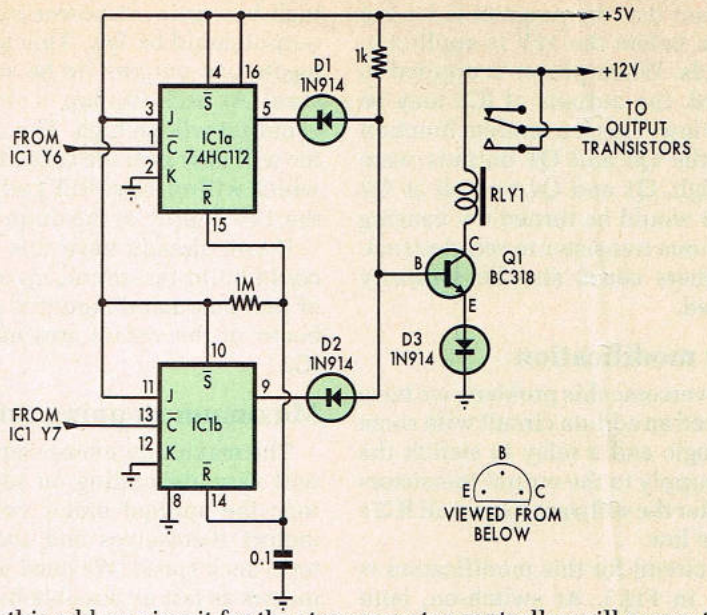
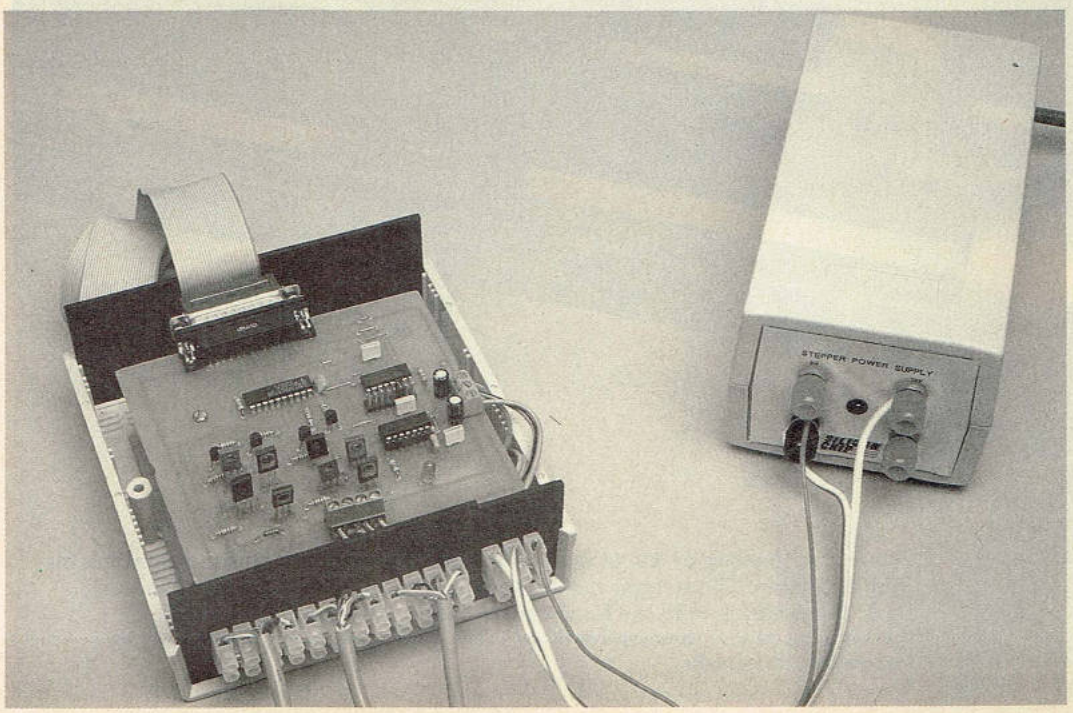


Fig 5: this add-on circuit for the stepper motor controller will prevent damage if two outputs are high at the same time. It can be built on a scrap of perforated board or even blank PC board.



This photo shows three projects: (right) the power supply for stepper motor cards (December 1997), and left, the controller for two stepper motors (September 1997) mounted in a case, together with the single stepper controller (August 1997) which will give X, Y and Z control. Whoops! Have we let the cat out of the bag? OK, an X-Y-Z table is planned for a future issue!

SERVICEMAN'S LOG

Life's tough without TimTams

I must be getting old because a couple of jobs really had me on the go this month. Fortunately, persistence won the day and I had a really good win over a recalcitrant VCR. If only I'd stocked up on TimTams . . .

Panasonic are up to sneaky things – they seem to think that people cannot remember anything that's older than 10 years and so now they are recycling their television model numbers (of course, in those days they were called National so it doesn't really matter).

This is extremely confusing for old codgers like myself who can still actually remember the original model. In this particular case, it was a model TC1401. The original cost over $550 and was an extremely heavy, 14-inch, portable TV set with a white cabinet and rotary tuning (VHF only). By contrast, the beast on my bench, also a model TC1401, was a dual-speaker 34cm set with remote control and a black cabinet. It weighs just 12kg and is so light that the owner has to be careful they don't lose their grip if they are carrying it in a heavy wind!

The complaint with this one was "no memory" – I'm glad I am not the only thing that suffers from this fault from time to time!

When the set was switched on, the only channel available was 1 and on opening the "Preset" menu all the channels were designated as "skipped". They could be retuned in any configuration you wanted, with the correct TV channel numbers, but when the Preset button was pushed again all the information was lost.

So the fault description at least was accurate and seeing as there is an IC (IC1104, MN12C25D) marked "MEMORY", the obvious thing to do was to replace it. I ordered in the chip, fitted it and switched on. Initially, this seemed to have fixed the problem because the set worked but then, after about five minutes or so, it failed again. Curses – it wasn't going to be that easy.

Next, I checked all the voltage rails, especially the 5V and 30V rails, but they were all OK. I even checked them for ripple using an oscilloscope but there was none. I also checked all the other voltage rails before going on to measure the voltages on all the pins of IC1104 and IC1102. There was nothing was untoward – not even a dry joint.

By now thoroughly frustrated, I reordered another MN12C25D IC plus an MN151142TEA (IC1102), if only to make sure that it really wasn't one of these chips. When they arrived, I couldn't wait to fit them one at a time. IC1102 was a bit tricky as it is a 42-pin high-density chip but eventually they were fitted properly and this time the symptoms were . . . exactly the same as before! This was definitely not the result I was looking for!

What next?

By now, I was totally perplexed by all this and was contemplating abandoning the repair. Maybe a cup of coffee would get the ol' brain cells working again? Well, maybe it did help because I was closely examining the main board (rather hatefully) when I noticed that the small glass diodes fitted to it were completely different to the diodes fitted in modern TVs (like 1N4148). And as I quickly discovered from the circuit, that was because they were completely different. Surprisingly, they were germanium OA90s, a diode rarely seen these days except in the odd discriminator. Yet here was a fairly modern set using lots of them and – hey-ho – they were predominantly in and around the memory circuit I was working on.

Well, this was all academic and of purely historical interest except, of course, one of the main reasons for the shift from germanium to silicon was reliability. Silicon diodes are much more reliable than their germanium counterparts and have better (read "less") leakage. The only drawback with silicon is that it requires 0.6V to bias the junction, as opposed to 0.2V for germanium diodes.

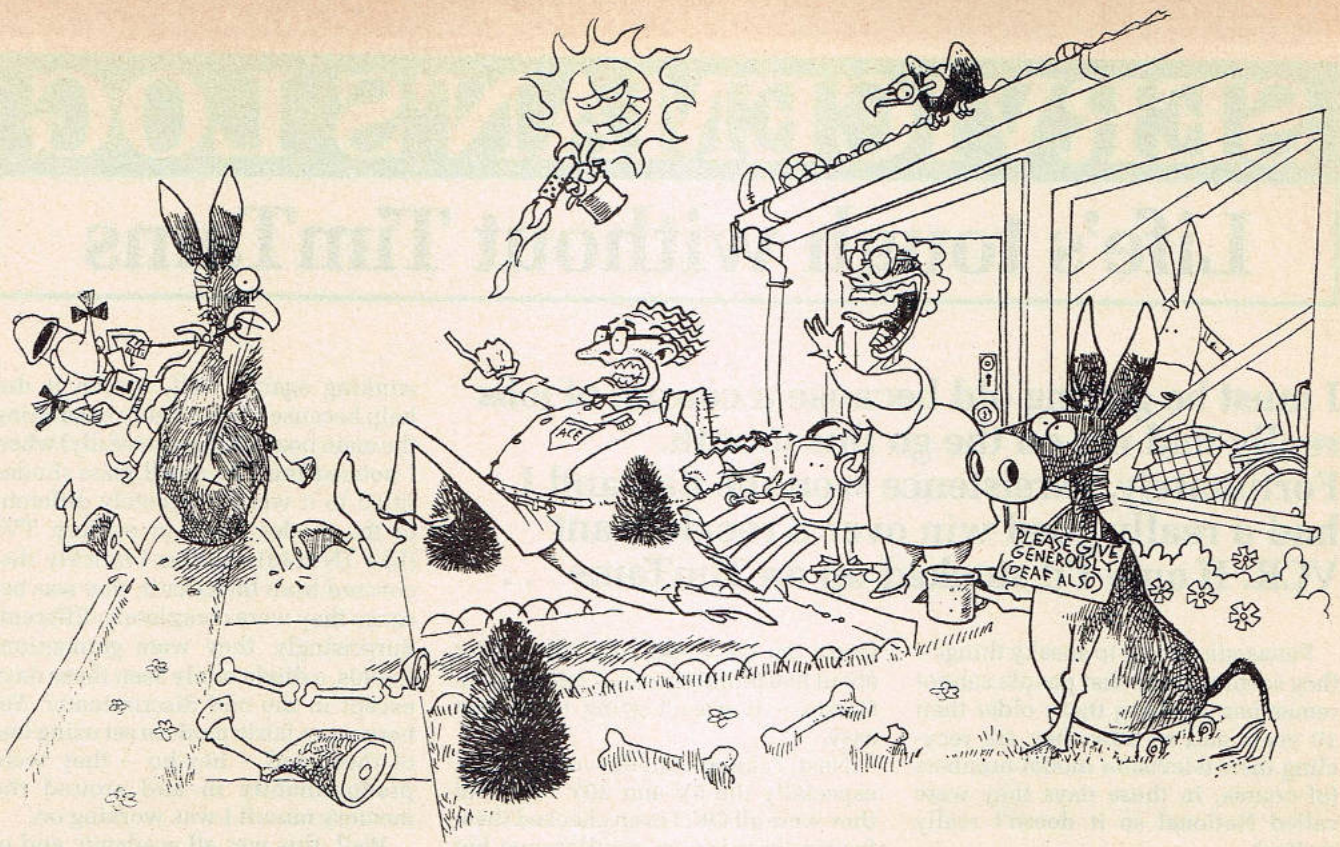
Well, I didn't have any better ideas, so I began testing each diode in circuit on the x10 ohm range of my multimeter. The reverse leakage varied a lot between them but at least there was a difference between the forward and reverse directions until I got to D1129. This diode connects pin 5 of IC1104 to pin 20 of IC1102, the microprocessor. D1129 measured nearly open circuit in both directions and it just had to be the culprit.

I rummaged around an old miscellaneous diode box and found an OA90 and fitted it. And that solved the problem – everything was now properly stored and remained that way even after the set was switched off. Without the benefit of a block diagram, I cannot tell the precise function of D1129 except to say it connects C2 with P32-C2 (I'm sure you are all the wiser for that bit of priceless information).

I have to admit this repair was pretty

Sets Covered This Month

- Panasonic TC1401 TV set
- Teac CTM-143 TV set
- NEC FS-6325 TV set
- AWA CT-1447AM TV set
- Mitsubishi HS-338A VCR



IT WAS A HOT DAY & I WAS RUNNING LATE
DUE TO THE CLIENT'S ADDICTION TO TALKING
~SHE COULD TALK THE HIND LEG OFF A DONKEY

fluky and I'm now off to buy a lottery ticket. Maybe I'll crack the jackpot?

Unhappy customer

Mr Burton wasn't too happy about his Teac CTM-143 TV set. It still had the same fault as when I'd fixed it last time, or so he claimed. Well, he may have genuinely believed this but it was 1996 when I fixed it last and I don't give 3-year warranties. And as it turned out, it wasn't the same fault as last time.

On this occasion, the set was intermittently not coming on and it appeared again to be a problem with the line drive stage in the 34cm Goldstar PC04A chassis. The previous fault allowed the set to start but it would then "go off" after a short period of time. This was caused by D402 in the 27V rail being open circuit. This allowed the driver stage power to start via D401 (18V) but because D402 was open circuit, the stage would then shut down.

This time, the voltage on the collector of Q401 (KTC2230A) was 20V. Sometimes there was a kind of square wave on this collector, while at other times the waveform collapsed into a reduced waveform with large negative spikes, which in turn produced a waveform on the secondary of T401. This was insufficient to turn on Q402 (KDS1555), the line output transistor. This was baffling because the square waveform on the base of Q401 seemed adequate to turn the stage on and, of course, it would have to be intermittent, just to complicate matters.

To eliminate any traces of the problem I had addressed last time, I connected an external variable power supply to the junction of C404 and T401 and pumped in 18-28V. It made no difference, thus eliminating the power supplies. The square waveform WF2 was correct at all times. I replaced Q401 and Q402 and the fault went away for one week but it was back again just after I had confidently given Mr Burton a quote for the fault.

Next, I checked all the components in the collector circuit of Q401 and in the base circuit of Q402, to no avail. So what was I overlooking? Basically Q401 is biased and switched on by the square wave arriving via C401 (which had also tested OK) but the waveform became distorted on its collector. Why? It's always the way; the simpler the circuit, the harder it is to find what's wrong.

The vital clue came when I monitored the waveforms with an oscilloscope. This showed that the amplitude of the waveform was much greater before R402 than after it. Certainly, the difference was much greater than I expected, considering that R402 is nominally only 560Ω.

When I removed R402 from the board and measured it, I found that it's value was actually 750Ω, an increase of almost 50%. Replacing this resistor increased the waveform amplitude at the base of Q401 and the set now remained on. I soak tested it for a week and crossed my fingers when Mr Burton collected it.

No TimTams

It was a hot day and I was praying that Mrs Norris' NEC FS-6325 TV set was going to be straightforward. I was running late because the previous job had taken far too long, due mainly to the client's addiction to talking – she could talk the hind leg off a donkey!

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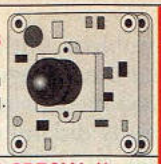

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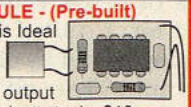

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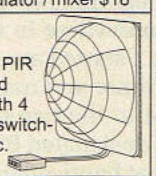

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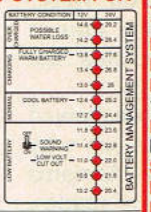
KITS OF THE MONTH

COMPLETE INTELLIGENT BATTERY / POWER MANAGEMENT SYSTEM FOR THE HOME OR CAR COMING SOON



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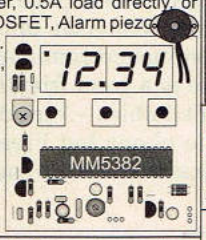

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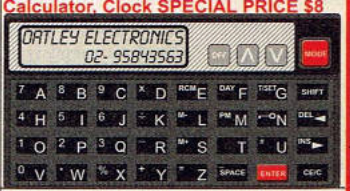
Stores Phone Nos. etc. plus Memos, Calculator. Clock SPECIAL PRICE $8



N E W * N E W *** N E W *** N E W**
PELTIER CONTROLLER: This kit is a sw-mode design & correctly controls temp. of peltiers to 10A (very efficient design) PCB + onboard parts + new surplus case. $15

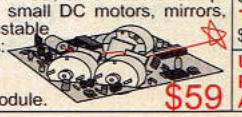
HAVE YOU MASTERED PIC PROGRAMING?...TRY OUR PROFESSIONAL. PIC MICRO PROGRAMER KIT.
Programs up to 39 Different 8, 18, 28, and 40 pin types of PIC chip. Quick Easy construction and uses serial programing method via your Pc's parallel port and uses BOJAN DOBAJ's software that works under Dos, Win3 & 95. Kit inc PCB plus all on-board parts but no PIC chip Just:$25...
16F84 PIC chips $12

$25

KEY-CHAIN LASER POINTER
650Nm High quality machined metal housing $18
LASER MODULE
650Nm as used in the above pointer. (Lm2) $14
NSW new laws may apply soon

SHOP MINDER / IR FENCE
IR transmitter & receiver kits (two separate PCB's), basic range is up to 20M but can be greatly increased by adding a lens. Output to drive piezo buzzers or relays etc. 2 PCB's + all on-board parts: $17. 2 suitable boxes + 2 swivel mounts: $6, Buzzer: $3, 12A relay: $3 (fits on PCB) Lens: $0.80

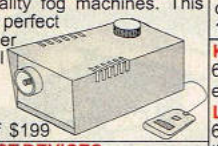
NEW SUPER LOW PRICE + LASER AUTOMATIC LASER LIGHT SHOW KIT: MKIII. Automatically changes every 5 - 60 secs. Countless great displays from single to multiple flowers, collapsing circles, rotating single and multiple ellipses, stars, etc. Easy mirror alignment with "Allen Key". Kit inc. PCB, all on board components, three small DC motors, mirrors, precision adjustable mirror mounts: (K115) + very bright 650nM laser (LM2) module.



$59

OPTO PACK 104 devices: various colours & types. Top brands. Siemens etc. just $10
VISIBLE LEDs...5mm...14X Yellow clear, 6X Red (clear) 24deg, 2X Yellow (clear) 24deg, 16X Red (clear) 24deg, 38X Green (clear) 24deg. **VISIBLE LEDs... 3mm...14X** Red diffused 70deg. 4X 3mm or rect. Yel. diffused 70deg **SPECIAL...1X** 5mm IR, 3X 3mm Clear Phototransistor, 3X 5mm Phototransistor, 1X IR RX module. 2X DIL rect. black PIN Photodiode.

FOG MACHINES..... JUST ARRIVED
Professional quality fog machines. This unit would be the perfect partner to our laser light shows, Ideal for discos, parties, fashion parades etc.
A special price of $199



PELTIER EFFECT DEVICES
Make a solid state food cooler / warmer for the car etc. with 2 heatsinks, a fan and one of the following. Could be used for cooling overclocked PC CPUs. All 40 X 40mm.
4A △T 65deg. Qmax 42W $25
6A △T 65deg. Qmax 60W $27.50
8A △T 65deg. Qmax 75W $30
Device comes with instructions to build cooler / heater plus data. Some used surplus heatsinks avail.

BULK BUYS

CIGARETTE LIGHTER PLUG & LEAD
With LED indicator, Fuse and small internal PCB. Space for small projects like voltage regulators etc.
10 for $4 or 100 for $30
CURLY CORD (two core)
With STD 2 pin MOLEX connecter & DC plug
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VOLTAGE REGULATORS (7812) 70c Ea. or 10 for $5
USED 27C256-20 EPROMS
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QUALITY DYNAMIC MIC INSERTS
SHURE brand MC125 $2 Ea.- 4 for $10

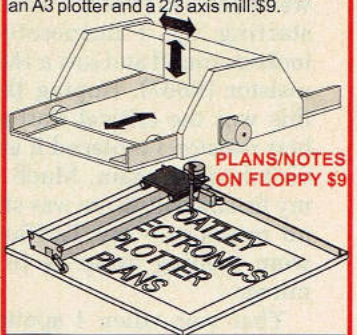
HUGE WEB SITE SALE
FROM JUNE 4th. until JUNE 7th
MORE INFO ON OUR WEB PAGE

BRAND NEW GERMAN MADE DUAL PRINTER / SCANNER MECHANISM
Made in 98, worth $1800!! Made for a govt. contract that failed. Use it "as is" or "Pull it apart" to recover:
SIX MINEBEA STEPPER MOTORS, 2x4 wire type 23LM-C355-38V 50x55mm, 3x4 wire type 17PM-H303-04V 37x 42mm, 1x4 wire type 17PM-M007-02, 42x33mm,
PCB WITH SGS STEPPER DRIVER ICS. POWERFUL, COMPACT, SW.-M0DE P.S. WITH FAN: 240V input, output: 1+5V/8a, -12v/ 1.5a, +12v/1a, +32v/4a.
NUMEROUS OTHER PARTS: Include **24 PIN PRINT HEAD, OPTICAL SCANNER, CPU, EPROM, matching BELTS & PULLEYS,** two **GEARED MOTOR ASSY'S** with micro switches, **MAINS FILTER etc. etc.**

UNBELIEVABLE PRICE: $36
Printer ribbon to suit $5, extra. Delivery to most Aust. cities $12, . box approx. 0.25 CM - 15Kg
MORE INFO, LINKS AND PHOTOS IN BARGAIN CORNER ON OUR WEB SITE

NEW MOSFET VERSION OF OUR 1/2/3 AXIS CNC(computer numerical control) SYSTEM. This system includes a new stepper motor driver kit (one kit required for each axis) designed to be used with software freely available on the Internet for use with home or professionally built a milling machine, lathe, engraver or cutter etc. with home & limit switches & a high degree of accuracy (can be better than .001". We supply the kit inc. Pcb all onboard parts etc. plus Internet resources for shareware software & building or buying mechanical components. Around $40 per axis. Call for details.

BUILD YOUR OWN COMPUTER CONTROLLED 2/3 AXIS CNC MILLING MACHINE / ENGRAVER OR PEN PLOTTER: Using the parts of the above printer, with the above stepper drivers and software and with the addition of about $10 worth of materials from your local hardware store you can build the machine of your choice. Plans/notes on floppy for an A3 plotter and a 2/3 axis mill:$9.



PLANS/NOTES ON FLOPPY $9

****LOOK** LOOK** LOOK****
NEW STEPPER MOTORS
30 oz./in. torque, 2.5 deg. 144 step, low voltage, compact 57 x 38mm: $14

COMPUTER CONTROLLED STEPPER MOTOR DRIVER KIT
can drive larger motors, Has optolsolation. Inc. Software & notes: $40 Or $50 with two Used 23 frame 200 step 1.8 Deg. motors!!
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KIT MADNESS SPECIALS

20A DC MOTOR SPEED CONTROL: $15. **FM TRANSMITTER MKII:** $15. **1 CHANNEL UHF REMOTE CONTROL KIT:** $35. **2 CHANNEL UHF REMOTE CONTROL KIT:** $45.. **8CHANNEL IR REMOTE CONTROL KIT:** $30... **LOGIC PROBE:** $8... **INFRA RED TESTER:** with case $7 **STROBE KIT:** $6... **UV MONEY TESTER:** $6

UNIDIRECTIONAL ELECTRET MICROPHONE: With tie-clip, plug and lead. Aplication notes supplied $4

SC-MAY-99

Anyway, if this next job was easy, I could still make it back to the workshop in time for a leisurely cup of coffee and a couple of "TimTams" before knocking off for the day.

When I arrived, I quickly unscrewed the back and it was easy to see why the set was dead – F601, a 2A mains fuse, was as black as the ace of spades. I unplugged the degaussing coils and measured the resistance across the bridge rectifier – it was still nearly a complete short circuit. By following the path from the bridge rectifier, I soon established that IC601 (STR-41090) was short circuit and hopefully the cause was due to the obvious dry joints on C609, the main tuning capacitor.

As luck would have it, I had a new STR41090 in the van. I quickly ran out, found it, shot back into the house and replaced it before you could say "Micky Finn". I then switched the set on and prayed hard but nothing happened. It looked as though I was snookered.

Suitably chastened, I turned the set off and measured the main HT voltage across C609. It was still 340V which told me that the circuit was stable DC wise but wasn't starting up. I desperately looked around and saw a 1MΩ resistor (R607). Hoping that this was the critical start-up bias resistor, I replaced it and switched on again. Much to my frustration, there was still no response – my TimTams were melting away as in a mirage.

That was when I spotted that R610 had a little chip missing from its body. There was enough of it left to determine that it was once a 1Ω resistor. I measured Q601 (sandwiched between R610 and R607) to find that it was short circuit as well. I tore back out to the van, rummaged through the mess in the back, found the parts I needed (miracles do happen) and rushed back inside and fitted them.

This time, the set fired up and the picture and sound were good. Thank you God, thank you.

I quickly scribbled out the bill, put the back on the set, hopped in the van and shot back to the workshop. I went straight for the percolator the minute I got back. Great; there was still some coffee left but what – NO MORE TIM TAMS. Life lost all its meaning!

Predictable trouble

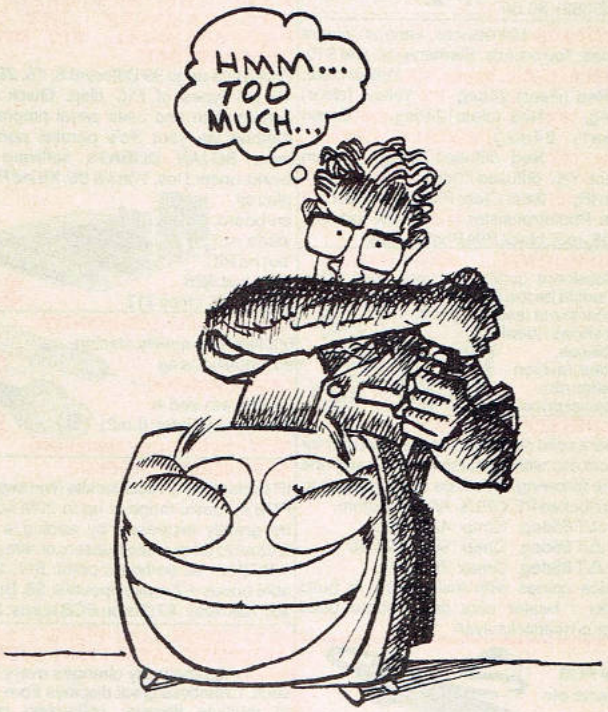
Mike Tester's (the name is changed to protect the guilty) AWA CT-1447AM was always going to be trouble. You see, Mike always fancied himself as a technician and he also lived near the sea. This combination meant his set was always breaking down and he was the kind of guy who liked to have a go. Well, this time there was no picture but the sound was good and there was a raster with the on-screen display working OK.

Anyway, it looked as though he had lost only the video between the IF detector and chrominance/luminance decoder IC. As he is a good friend of mine – despite his foibles – I tried to help him over the phone but I really didn't have a clue as to the exact cause of the problem. Initially, I told him to check all the voltage rails, especially those feeding the signal circuits. This he dutifully did but everything measured fine, so I told him that the only course of action was to feed in a signal from a colour bar generator and trace it through with an oscilloscope. After a bit of coercion, he finally agreed and dropped the set off at my workshop.

When I removed the back, I could see how rusty the whole set was from the salt air. I started by confirming everything he did by checking all the voltage rails. These all proved OK, so I hooked up the oscilloscope and followed the video from the video detector (pin 10 of IC101, MS51496P) through to Q1A0 TP12 (waveform 1), thence to LC201 DL/BPF and finally to pin 18 of IC201 (M51412SP). After that the scent became very cold.

I then spent an inordinate amount of time examining the contrast control circuits but got nowhere. By now I was beginning to think that the fault was somewhere in the beam limiting circuit. I started at pin 8 of the flyback transformer and traced the circuit until I got to the two beam limiting test points designated PT1 and PT2. It was then that I noticed that R555 and R556 were badly corroded. I desoldered them and measured them to find that they were both nearly open circuit.

Replacing them fixed the problem completely but I had to warn Mike to keep the set dry, otherwise it wouldn't last very long. Unfortunately, he didn't listen too well and within another three months the set was worse than before and he was forced to bin it.



...I WAS BEGINNING TO THINK THAT THE FAULT WAS SOMEWHERE IN THE BEAM LIMITING CIRCUIT

A Heath Robinson job

Mrs Daniels, a widower living in a housing commission flat, was a very keen soap watcher and loved to record her serials every day on her beloved Mitsubishi HS-338A video. She first brought it in complaining of poor fast forward and rewind, which just turned out to be belts and tyres, but a month later it was back. This time, the complaint was "snowy pictures".

At the time, I felt sure it was just dirty heads but after cleaning them vigorously I came to

the conclusion that the heads were worn out, especially as (with the same tapes, at least) I was getting almost clear pictures with Pause/Freeze Frame/Still. I removed the heads and checked them on my tester to find that they were indeed low – enough, I thought, to be causing the problem. When faced with the news, Mrs Daniels was very stoic, accepting that as it was in use every day, the heads were bound to wear out eventually. And although she could hardly afford new heads, she would find a way to come up with the money as it really was her main source of entertainment.

I ordered in the new heads, fitted them and confidently switched the machine on. To my horror, I found that the problem was just as bad as before, although the picture was still OK when paused. It was obvious that I had misdiagnosed the fault.

I got the CRO out and examined the FM envelope at TP-2A to find half of it missing. It was unlikely to be the new heads but it could be the head amplifier IC, the switching pulse or worse still, the toroidal transformer inside the drum itself.

Using the second channel of the CRO, I quickly established that the switching pulse (FF or flipflop on pin 2 of IC201 M51473P) was exactly in phase with the FM envelope switching. From there, it didn't take long to find that the toroidal transformer primary measured 100kΩ between pins 1 and 2 of plug SB. I removed the entire drum assembly, then removed the drum motor and upper transformer to reveal the lower primary coils glued to the bottom with – yes, you've guessed it – the notorious brown glue.

There was nothing that could be done to fix it as the coils were only accessible on the underside and the transformer was glued too tightly to the base. Unfortunately, the trade cost of a complete drum assembly was a prohibitive $416.18 (if indeed it was available), so I tried to obtain a junked machine from one of my colleagues in the trade.

Two heads or three

When I enquired, one young technician asked me whether it was the 3-head version (which it is) or the earlier 2-head HS337A. At first, I didn't quite realise the significance of his question but he went on to suggest that I substitute the pause head and its winding for the open circuit winding. At first I thought that this was an absurd idea, knowing the tolerances these heads are made to, but having had no success in obtaining a second-hand drum assembly, I decided to at least give it a try.

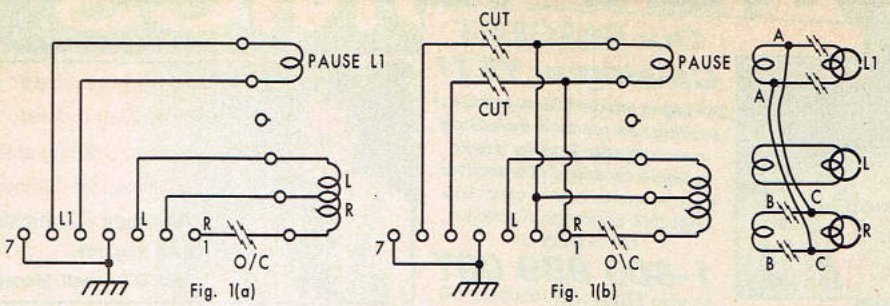


Fig.1: this diagram shows how the connections to the transformer windings inside the drum were modified. Fig.1(a) is the original circuit, while Fig.1(b) is the modified circuit. Fig.1(b) also shows how the leads to the heads were modified on the top of the drum.

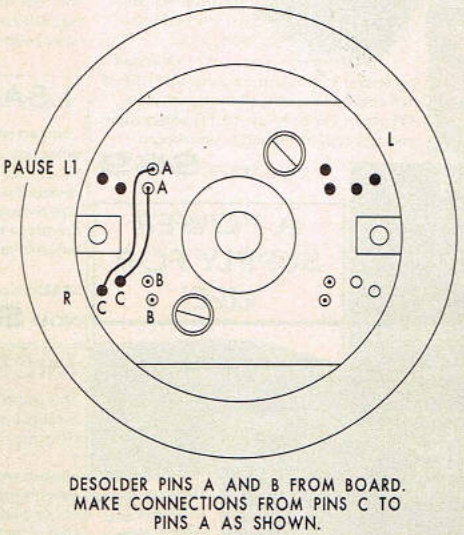


Fig.2: here's how the connections to the head terminals on the top of the drum were modified. The pins were desoldered from the PC board at all points marked A and B and the two pins at A then connected to pins C using short lengths of insulated wire.

This photograph shows the modified drum assembly. Amazingly, it worked and produced quite a good picture.

First, I completely reassembled the drum, refitting the old heads in the process. I then fitted two jumpers across the toroidal transformer primary windings, connecting the pause head on winding (L1) in parallel with the open circuit winding (R). There was an added complication in that the open circuit winding (R) shared the centre tap with the good winding (L).

I now had to guess which head was which on the upper drum, as they are not marked anywhere. The pause head is L1 and I reasoned that this would be mounted close to play head L, which would be diagonally opposite head R. I then unsoldered head R, fitted two links to the pause head winding (L1) and tried it out. It made no difference, which meant that I probably had the L and R heads mixed up.

Next, I assumed that the heads were arranged as shown in Fig.2, with the R head adjacent to the pause head (L1). I then rearranged the leads as shown so that the active heads were L and R but I still didn't really expect it to work. However, I was thrilled to see that it actually did work and what's more, the pictures were pretty good. Even more surprisingly, the pause mode wasn't bad either.

I then made a recording and played it back and the picture was still quite acceptable. Frankly, I was amazed that this had worked at all and I am full of praise for my friend. Obviously, it isn't perfect but Mrs Daniels thought it was acceptable under the circumstances, especially as I didn't charge her for the new heads and put them back into stock. **SC**

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Lost or damaged your original remote?

Pre-programmed codes to suit all popular makes of Televisions, VCRs and CATV, this is the answer. It also combines the functions of your TV, VCR and CATV into just one unit! Simple to setup and use.

Don't spend $100's on an original remote when you can have all the same functions for a fraction of the cost!

A 1005 **$48.95**

DC-DC Converter

Converts 24V DC to 13.8V DC for use with stereos, CB radios, two ways etc. Suitable for vehicles fitted with 24V electrical systems, eg. trucks, boats, tractors etc.

Features: • Overload protection • Over-current protection • Rated at 8 amps continuous, 10 amps peak • On / Off power switch • Fused • Extremely compact and rugged • Quality construction

M 8162 **$69**

Laser Pointer

This handy little keychain unit is ideal for lectures, seminars, building sites, guided tours, and it's much less intrusive than a standard "stick" type pointer. Uses three button cells (included). Complies with new regulations governing the output power of laser pointers. (< 1mW output).

Why pay $39.95 elsewhere ?

A 0205 **$19.95**

1.5A Regulated Supply

Compact sturdy power supply, capable of delivering a constant 1.5A at 3V,4.5V, 6V, 7.5V; 9V and 12V. Ideal for voltage sensitive devices like portable TV sets, video games, tape recorders, radios, scanners, computers. Features a mains on/off switch, power on indicator and binding post connections.

Includes Short Circuit, Thermal & Overload Protection!

M 8230 Normally $49, NOW **$39.95**

UHF Remote Control Switch

This little gadget can easily be used to create a very simple panic alarm, remote lighting control or to control any other item you may wish to operate remotely. One remote and receiver are included in the package. The receiver can operate in 3 modes:

- **On/Off** The contacts are switched alternately,
- **Momentary** The contacts are held closed while the button is held down in the momentary mode.
- **Panic** The button must be held down for 2 seconds to operate the relays and also trip the transistor output.

Features: **• Latching/Non-latching Contacts • 2 Relay & 1 Transistor Outputs • Panic Mode • Code Hopping • Audible confirmation • Incorporates handy key ring • 387 billion combinations • 30m operating range (open area) •24 V DC 1 Amp contacts**

Ideal for controlling your lights, garage doors, etc

A 1018 **$110**

A POWER SUPPLY FOR LIFE!

Precision Digital LCD Volt and Current meters accurate to within 0.5%!

A lab supply with a main output rail adjustable from 0 to 30V, at up to 2.5A.

Features: • Separate controls for voltage and current limiting • Fixed 12V and 5V output rails, at up to 1A peak • Precision digital LCD Voltage and Current Meters for fine adjustment for use in research labs, instrumentation testing, digital circuits, etc.

M 8200 Was $229, NOW **$189**

MICRON 20W Soldering Iron

This powerful 20 Watt soldering iron features a high efficiency patented heating element and a long life interchangeable iron-clad tip. It's supplied with a 1.6mm conical tip that is ideal for general assembly work. 3 different tip sizes available, 370°C fixed temp.

T 2420 **$29.95**

FREE ACCESSORIES!

Receive a T 1100A 200g solder roll, a T 1310 Iron stand, together valued at **over $20**, ***FREE*** with every T 2420!

BE QUICK! Limited to First 50 Callers Only!

PIR Door Minder & Alarm

Ideal door minder for shops, automatically announces when customers arrive! Similar models sell for over $100 or more!

An excellent DIY unit for use in home, office, shops,etc. Two modes of operation: • Entry/exit chime activated by an external switch or by movement detected by the PIR. • Alarm mode, when activated the alarm sounds for 30 seconds. ***Features:*** • 10 Metre detection range • Simple and easy to install • Self-contained unit • Swivel mount bracket • Remote doorbell contacts • Doorbell only operation when in Off mode • Ideal as a travellers intruder alarm

S 5320 **$39.95**

M 9600 9V DC Plugpack to Suit **$13.50**

Panel Mount Voltmeters

These compact voltmeter modules are ideal for applications requiring a professional finish and digital accuracy. The decimal place can be configured as desired and both units feature a plastic bezel surround.

Specifications:

Digits:3.5, 13mm Height
Range:.....200mV DC
Power Supply (Q 0570):9V DC
Power Supply (Q 0580):.....5V DC
Accuracy:.....±0.1%

These panel meters can share a common ground with the voltage being measured, unlike many other panel meters on the market.

Q 0570 LCD Module **$25**

Q 0580 LED Module **$25**

120W Gas Soldering Iron

AT LAST! A BIG GAS IRON!

This butane powered iron has a HUGE 120W heat capacity. Features a "one-touch" piezo ignition for super-easy starting, and a thumb-wheel heat control. The massive 33cc gas storage chamber is refilled using a standard butane refill canister. A MUST for installers, mobile technicians, on-site service personnel, auto-electricians etc.

T 2600 Normally $99, NOW A CRAZY **$89** ea

"This has all the convenience features of a normal gas iron, such as quick heating, no power cords, light weight and best of all, it comes with a blow torch tip."
Silicon Chip Magazine, Sept '97

For this month only!!
SUPER SPECIAL! The first 100 callers to purchase a T 2600 or T 2601 receive a roll of T 1100A solder and a T 2449 Butane Refill, together valued at $10.45 FREE!

7 in 1 Pro 120W Kit

The T 2601 kit comprises of the *T 2600* Gas Soldering Iron PLUS a handy carry case with a range of tips and accessories including cleaning sponge, solder dispenser, blow torch, hot air blower and hot knife cutter.

T 2601 Normally $149, NOW **$129** ea

MASSIVE 120W Heat capacity! Simple "thumb-start" piezo ignition refillable gas storage!

Aluminium Tool Case

This quality aluminium tool case features 5 adjustable dividers for organising your tools and equipment. It also includes 17 tool pockets and a removable lid insert which can be used for smaller hand tools. Supplied with two keys and measures 460 x 325 x 150mm. Features all aluminium side panels, unlike others around which have plastic panels!

T 5020 Tool Case **Was $65, NOW $55***

*Tools not included

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OVERNIGHT DELIVERY

CCD Surveillance Cameras

All models feature composite video output suitable for direct connection to the video input on a VCR, Monitor or an AV transmitter. The addition of an RF modulator can also allow the camera to connect to the antenna input of a TV or VCR.

Ideal for use in Shops surveillance systems, door monitors, monitoring machinery and other security or safety applications.

Ceiling mounted compact dome camera is ideal for shop surveillance systems. It's visible appearance makes it an excellent deterrent to would be thieves.
Requires regulated supply. (M 9516)

S 9110 **$149**

Features: • Simple to install • 3 Wire Connection • Composite Video Signal Output • Compact design • 500 x 582 pixels • 380 lines • 12V DC Operation

Miniature Cameras. 3 models available. 2 surveillance only (S 9000/50). The other model includes a microphone for audio (S 9005). Supplied with in-line BNC connectors for video and a DC Jack for powering the unit, the S 9005 also has an RCA connector for audio output.
Requires regulated supply. (M 9516)

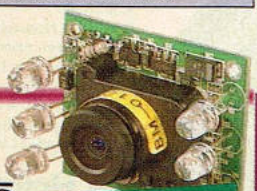
Ideal for use in shop surveillance systems, door monitors, video intercoms, reversing monitor for large vehicles, and security or safety applications.

Features: • Simple to install • 3 Wire Connection • Composite Video Signal Output • Small unobtrusive size • 500 x 582 pixels • 380 lines • 12V DC Operation • Diecast housing • Adjustable swivel bracket

S 9000 B&W RRP **$139**

S 9005 B&W + Audio RRP **$169**

S 9050 Colour RRP **$249**



PCB & Lens Cameras. Using only a 3 wire connection, these mini cameras can be installed so they are virtually undetectable. 3 models to choose from.
Requires regulated supply. (M 9516)

S 9010 B&W RRP **$125**

S 9030 B&W with Infra Red Illumination RRP **$135**

S 9020 B&W Pin Hole RRP **$125**

Ideal for use in Shops surveillance systems, door monitors, video intercoms, monitoring machinery and other security or safety applications.

Add-On Audio Module

This module enables you to receive audio as well as video from your surveillance camera. Designed to fit directly onto our PCB module CCD camera S 9010, the unit is supplied with all leads for easy installation.

S 9100 **$19.95**

Regulated Power Supply for CCD Cameras

This plugpack has a regulated output, and is suitable for powering the CCD cameras above. 6, 9 ,12VDC @ 500mA.

M 9516 **$28.95**

4 Way Audio Visual Camera Switcher

Monitor up to 4 A/V channels with this advanced automatic A/V switcher. Any combination of the four cameras can be scanned and displayed on either of the two monitors, it switches both video and audio. The time and date is displayed on both monitors making it ideal for surveillance applications. The scan rate and duration of each camera can be configured using the on screen menu functions.

S 9200 **$225**

Integrated PIR & CCD Camera with Audio

Can be configured to trigger a VCR to record an intruder's movements!

Similar in operation to the cameras above, this combination camera / PIR is an ideal low cost *total* surveillance solution for the small office, business or home. It's very easy to install and connect with all mounting hardware including a unique swivel mounting bracket and connectors supplied. Features N.O. & N.C. switched contacts for triggering an alarm or remotely controlling a VCR/TV for unattended recording. Dimensions: 115L x 60W x 30.8D

S 9040 **$249**

Illuminated Magnifying Lamp

"Fantastic for servicing PCB's and identifying micro miniature components"

The magnifying head is easily set to the desired position on it's spring-loaded arm assembly. Simply clamps to your workbench or desk.
As you grow older, it's inevitable that your eyesight is going to falter. Maybe you're already finding it difficult to read those tiny zeners or find that small solder bridge on your PCB. If so, this magnificent 3 dioptre illuminated magnifier could be the solution for you. Uses are not only limited to electronics, of course. It's ideally suited to stamp and coin collectors, model makers, embroiderer, jewellers and the like.

No workbench should be without one!

A 0970A **$129**

33Pcs Driver Bit Sets

All housed in a handy plastic holder. Great for the toolbox, workbench, etc. Suitable for use with battery drills or most hex bit drivers.

T 2182 Driver Set contains: • 5 Slotted • 8 Phillips • 7 Pozi • 6 Hex • 6 Star • 1 Magnetic Bit holder

T 2180 Security Bit Set contains: • 4 Triwing • 9 Torx • 4 Snake Eye • 12 Hex (6 Metric & 6 Imperial) • 3 Torque • 1 Magnetic hex extension bar

T 2182 **$13.95** T 2180 **$13.95**

The Holy Grail of screwdriver bit sets!

BONUS! Buy Both sets for **$26**

19 Range Pocketsize DMM

Great for the trades person on the move, or for a student lab kit. Includes an audible continuity buzzer, 'K' type thermocouple, and square wave test signal output. Measures DC Volts to 1000V, DC Amps to 10A, AC Volts to 750V, resistance to 2MΩ and temperature from -20°C to 1370°C. It even includes a diode test function! Measuring only 70 x 126 x 25 mm and weighing only 170g, this meter is a pocket rocket with a price to match!

Q 1051 Was $29.95 NOW JUST **$20**

Q 1054 Carry Case ONLY **$5**

Includes Temperature Probe & Thermocouple for Measurements up to 1400°C!

24 Pcs Combination Tool Kit

Includes: • Side cutters • Long nose pliers • 6 Jeweller screwdrivers • Tweezers • Handle plus extension bar • 4 Sockets, 7, 8, 9 & 10mm • 9 bits, 2 Phillips, 2 Slotted and 5 star
All housed in a plastic fold up case. Great for the toolbox, workbench, etc.

T 2170 **$23.95**

Excellent value at less than $1 a tool!

Micron Desoldering Tool

Desolders a 14 pin IC in around 30 seconds!
The T 1280 makes it a breeze to remove components from any PCB, even double sided, through-hole plated boards. All it needs is a squeeze or two on the trigger and the component virtually falls out. **Features:** • Totally self contained • Light and compact • Anti static tip • Safe & easy to use • Simple to clean and maintain • Variable tip temperature. The *Sure Shot* generates a high speed vacuum every time the trigger is squeezed. This vacuum sucks the molten solder into the collection reservoir of the unit. Here the molten solder solidifies into small particles.

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Replacement Tips
T 1282 1.0mm Tip $34.95
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BONUS OFFER!
The first 50 callers to purchase a T 1280 receive a T 1274 Bench Stand , valued at $24.95, **FREE!**
The T 1274 keeps your desoldering tool safely upright on your workbench and shields the hot element!

300W Mini Inverter

Bonus Offer! This month, every M 8115 comes with a P 0150 Lighter Socket Double Adaptor, worth $12.95, FREE!

Powerful, compact & robust!

This amazing inverter provides up to 300W of 240V AC power from your car cigarette lighter socket! During our evaluations, it ran our entire A/V room setup, including a huge 68cm television and A/V amp! Can power televisions, VCR's, lights, Phone and Camcorder battery chargers, shavers and hi-fi systems. Features low battery indicator and overload shutdown. Built-in 3-pin plug (no adaptor required). Includes car cigarette lighter socket lead.

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Coaxial speakers placed in car doors often suffer from "treble muffling", as the tweeters simply fire straight into the passenger's legs, or straight across the car at ankle height, which isn't much good for imaging or sound quality. This 165mm split system enables you to mount the 6.5" mid bass driver in the door, and the dome tweeter on the dash or on top of the door trim for optimal staging, ie "on axis".

The C 9302 split system comes complete with two-way crossovers, mounting hardware, grilles and speaker wire. Impedance: 4 ohm, Power Rating: **100W RMS**, Freq. Response: **55Hz - 20kHz**

C 9302 **$179.95**

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These high power subwoofers are essential equipment for big car audio systems. Producing deep vibrations and thunderous rumble, they'll keep even the biggest bass fans smiling. They feature long throw surrounds and highly rigid cones to minimise distortion at the limit. Equally at home in sealed or vented enclosures, they can be used in single- or multi-speaker sub cabinets. And not only do they sound incredible, they're mirror finish cones give them plenty of visual impact, as well!

See our 1999 Catalogue page 168 for full specifications.

C 3048 200mm (8"), 4Ω, 160W Subwoofer **$119**

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C 3052 300mm (12"), 4Ω, 250W Subwoofer **$169**

TURBOCHARGE YOUR SOUND MACHINE! These HIGH POWER, HIGH PERFORMANCE drivers are a must for the serious sound enthusiasts!

ALL DRIVERS FEATURE MASSIVE DOUBLE MAGNETS FOR HI-PERFORMANCE!

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(Exclusive to Altronics)

A simple hobbyists device to allow you to provide laser beam security to a room or a building perimeter. The perimeter alarm will sound a piezo buzzer or trip a relay when the beam is cut from the IR detector. *Features* • Simple to construct • Operates off + - 9V supply, nicad or 18VAC plug-pack • Supplied with a low profile case

Announce Guests or add an ear piercing siren to create a simple intruder alarm!

K 1935 **$34.95** A 0202 Laser Pointer to Suit **$45**

Surround Sound Decoder

Add some dimension to your favourite music, videos, laserdiscs or PC games with this fantastic new Surround Sound Decoder Kit!

(May 1999 EA)

Based around a similar design from EA in May '95, this all new design features a digital delay circuit. Easy to construct and install.

Features • Housed in a robust ABS Instrument Case • Screen printed front and rear panels. • Selectable delay time from 0 - 33 milli-seconds • Indicator for selected delay time • 6 RCA outputs; L channel, R channel, center, rear, sub + and sub - (for bridging) and Delay out (rear with delay) 3 inputs ; Left , Right and Delay input

This project will add incredible realism to any sound track at only a fraction of the cost of most units available on the market!

K 5590 **$120**

Mobile Hard Drive Bays

Need to transfer large amounts of data between two locations or have a multi-purpose slot in your case ?

Includes a built-in Cooling Fan!

This mobile rack kit is supplied in two parts. Part one is the cradle which mounts into a standard 5.25" slot in your computer and connections are simply transposed from the drive to the cradle. The second part is the removable tray that can be slotted into any computer fitted with the cradle above. Your original device simply screws into the removable tray and slots into the cradle for normal operation. Features Power & HDD activity LED display, fan cooling. It can be utilised for hard disk drives, ZIPs, LS-120, DATs.etc.

D 5500 IDE Type **$39.95** D 5510 SCSI Type **$45**

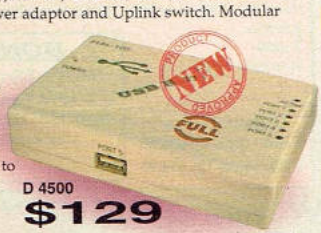
5 Port 10 Base-T Ethernet Hub

Ethernet Hubs are widely used in the commercial market and are now becoming more popular in the domestic sector with the advent of many new programs that demand a fast and reliable link. ie. Games, Internet, etc. The 5 port HUB will allow the user to interconnect up to 5 computers or more by using the uplink jack to connect additional HUBs. The HUB offers greater integrity than that of a 10 Base-2 network by using a star topology. ie. If one computer connection is faulty the complete network does not grind to a halt.

Features include individual port Link/Activity, Power , Collision LED indicators. Compact size for desk mounting, includes power adaptor and Uplink switch. Modular design allows for expansion.

D 4300 **$99**

5 Port USB Hub



This tiny 5 port desk mount HUB is suitable for connecting all your peripherals. For instance modems, printers, keyboards, mice, CD ROMs, Scanners, etc. The HUB requires no external power and has 1 "upstream" output to connect to your computer and 5 "downstream" inputs for device connections. Dimensions: 125L x 85H x 30H

D 4500 **$129**

Deluxe Multimedia Stereo Headset

This lightweight multimedia headset is fitted with adjustable padded headband and leatherette earpads making them comfortable for periods of long use. It's also supplied with an in-line volume control. Ideal for use for voice recognition, internet phone, multimedia applications, interactive games. It comes complete with a 1.8M lead fitted with 3.5mm stereo jack plug for microphone and speakers. Suitable for all sound cards.

Headphone		*Microphone*	
Freq. Resp.:	20Hz - 10kHz	**Freq. Resp.:**	100Hz -10kHz
Impedance:	32Ω	**Impedance:**	2kΩ
Sensitivity:	92dB	**Sensitivity:**	-68dB± 3dB

C 9022 Normally $39.95, NOW **$35**

Multimedia Microphone

This ultra sensitive "plug and play" microphone is ideal for use for voice recognition, internet phone, multimedia applications, interactive games. It comes complete with a 3.5mm jack plug and is suitable for all sound cards. Can be desk mounted or direct mounted to your monitor.

Freq. Resp.: 50Hz-13kHz
Impedance: 1.4kΩ±30%
Sensitivity: -58dB± 3dB

D 0900 Normally $12.95, NOW **$9.95**

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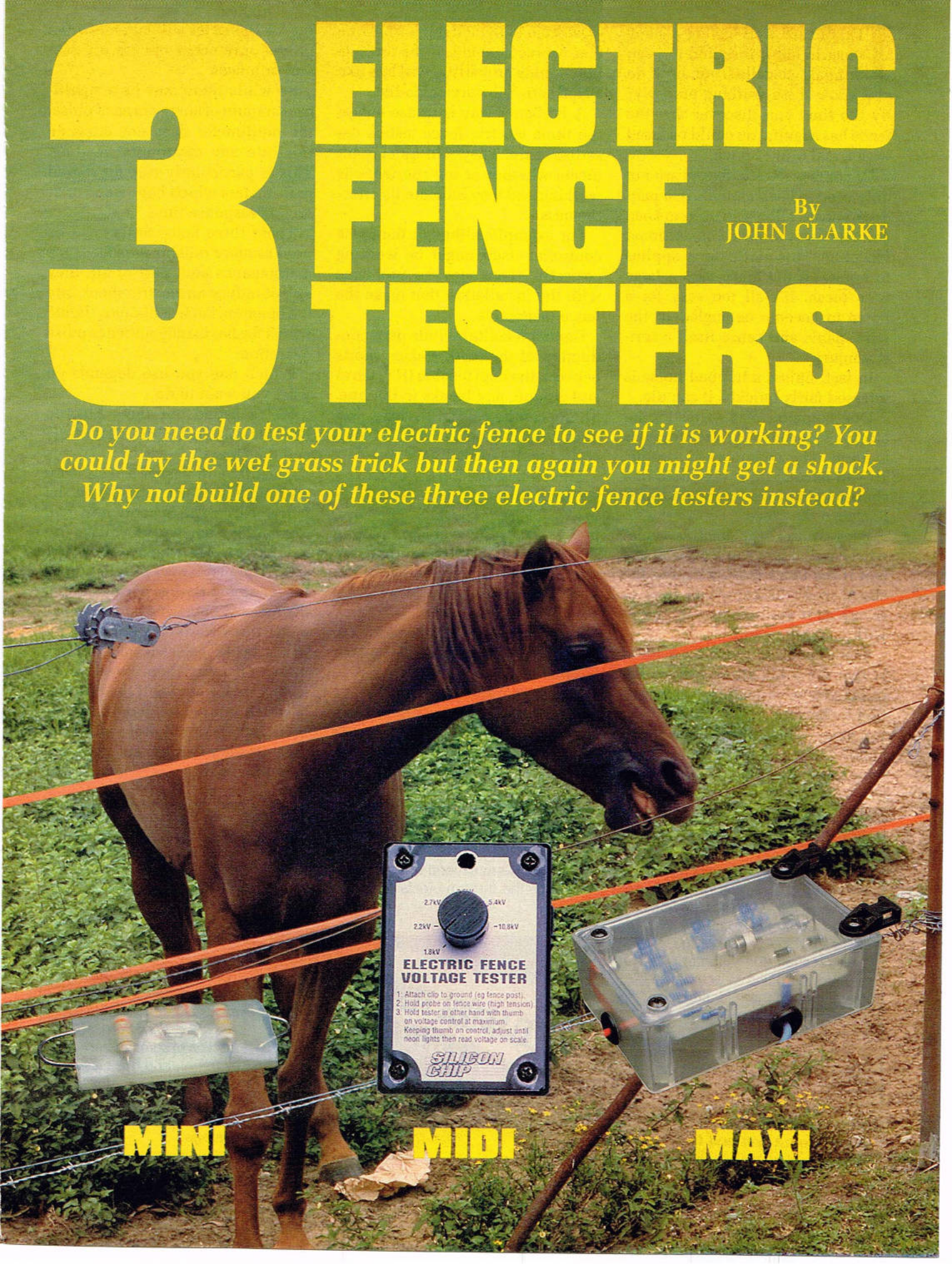
Doc.GL778

3 ELECTRIC FENCE TESTERS

By JOHN CLARKE

Do you need to test your electric fence to see if it is working? You could try the wet grass trick but then again you might get a shock. Why not build one of these three electric fence testers instead?


2.7kV
5.4kV
2.2kV
10.8kV
1.8kV
ELECTRIC FENCE VOLTAGE TESTER
1. Attach clip to ground (eg fence post).
2. Hold probe on fence wire (high tension).
3. Hold tester in other hand with thumb on voltage control at maximum.
Keeping thumb on control, adjust until neon lights then read voltage on scale.
SILICON CHIP
MINI
MIDI
MAXI

It's all very well having a fancy electric fence installed to keep animals corralled but how do you know if it's working properly? By the time you discover that the fence has a fault, you could be faced with a real roundup job.

Of course, electric fences are not only used to keep animals in a paddock but are often also used to keep animals away from a conventional fenceline. This particularly applies to horses. If the fence uses a large wire mesh, it's all too easy for a horse to become entangled in the wire, panic and cause itself a serious injury.

In fact, unless a trapped horse is released fairly quickly, it can die.

One common way of testing an electric fence is to use the wet grass method. The technique is simple: all you have to do is take hold of a short length of wet grass and touch it against the fence.

Because the wet grass is somewhat conductive, you'll get a bit of a belt if the fence is working but the shock won't be anywhere near as severe as if you touched the fence with your bare hands.

The drawback with this method is that it's a bit hit and miss. Because you're (hopefully) only getting a "bit of a tingle" through the wet grass, you can't tell how much "bite" the fence really has. That's why some hardy souls choose the direct touch method but it's not one that we recommend. If the fence is functioning properly, it will bite like a Northern Territory crocodile.

A far better way is to use one of the three electric fence testers described here. They will quickly indicate whether or not the fence is working and also indicate its effectiveness.

For example, although the fence controller itself might be working correctly, there may be problems with the installation that make the fence ineffective.

Common faults include poor conduction of the earth stakes, shorts between the high tension (HT) wires and ground, and breaks in the line. Shorts can be caused by long, wet grass brushing against the HT line and/or faulty insulators.

Sometimes, the further away you get from the controller, the less effective the fence becomes. This commonly occurs if wet grass is loading down the controller's output. It's possible too for one section of the fence to go completely "dead", due to a break in the line.

For this reason, it's a good idea to check all sections of the fence on a regular basis.

Unfortunately, you can't use a standard multimeter to test an electric fence. This is because the peak voltage on the fence can be as much as 10kV, with each pulse only lasting for 1ms or less. What's more, the pulses only occur once every second or longer.

So while there may be a significant amount of energy in each pulse, the multimeter does not integrate this into any meaningful reading. This is particularly true for digital multimeters which have a one or 2-second response time.

These three fence testers can be used as more reliable aids for fence maintenance and, best of all, they do not induce an electric shock into the operator. Each contains a "light" which flashes to indicate fence pulse operation.

Which one you use depends on what you want to do.

We've called our three Electric Fence testers the "Mini", the "Midi" and the "Maxi".

The first unit flashes a neon lamp each time it detects a pulse on the fence, while the second unit can measure the fence peak voltage (up to 10.8kV). The third unit is designed for permanent installation on the fence and flashes periodically if the fence is operating correctly.

All three units are powered directly by the electric fence being tested. That way, there are no batteries to replace or leak if the unit has been left unused for some time.

OK, let's take a look at each of our fence testers in turn and find out how they work.

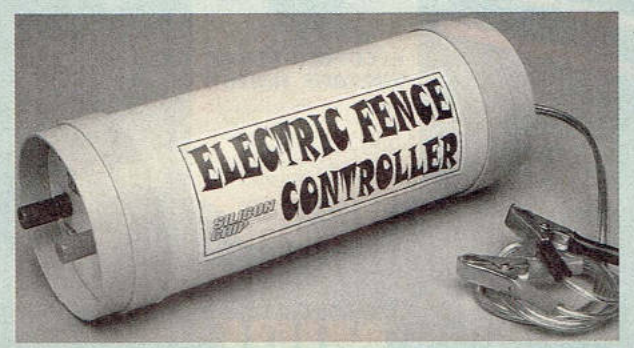
WHY AN ELECTRIC FENCE TESTER?

This project grew out of necessity: we needed a means of testing the output of the SILICON CHIP Electric Fence Controller, featured in last month's (April '99) issue.

We called for volunteers around the office to act as a tester using the old finger-on-the-fence-and-hope-it-doesn't-hurt-too-much routine.

But there were no takers! (Even Ross Tester refused to live up to his name . . .)

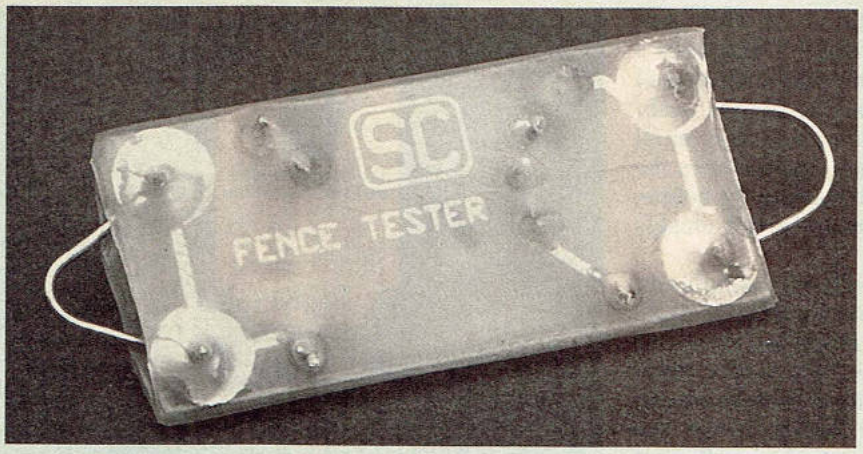
So we looked at ways of testing the electric fence without getting a belt and found that there were several ways to do it – hence the three projects featured here.



Incidentally, if all this talk about electric fences and controllers is foreign to you, it's probably because you missed out on last month's issue of SILICON CHIP.

The high power electric fence controller shown here was described in detail in that issue. It's easy to build, costs a fraction of commercial controllers . . . and back issues of the magazine are still available for $7.00 including P&P – a bargain in anyone's language.

"Mini" Electric Fence Tester



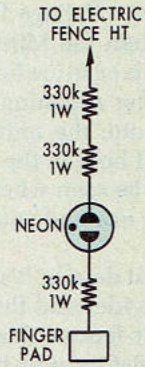


Fig.1 (above): the mini electric fence tester is simply a neon lamp in series with enough resistance to stop you getting a belt!

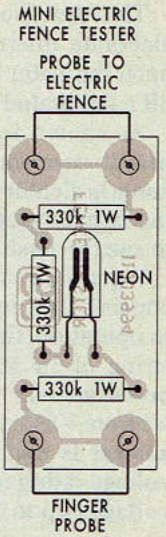


Fig.2 : the PC board layout. Construction is simplicity itself! The hardest part will be soldering the wire loops.

Fig.1 shows the circuit of the Mini Electric Fence Tester. It is a low-cost unit that's easily carried in a shirt pocket and can be quickly used to indicate whether or not a fence is working.

This is the simplest of the three units and uses just a neon indicator and three 330kΩ resistors. These parts are all mounted on a small PC board and there are two contacts, one at each end. In use, one contact (the finger pad) is held in the fingers and the other is touched onto the electric fence wire. If the fence is operating correctly, the neon indicator will briefly flash each time the HT wire is pulsed.

The total resistance in series with the neon indicator (3 x 330kΩ) limits the current flowing from the fence and through your body to ground. In practice, this current is so low that the pulse will not be felt. Note that the light output from the neon indicator is quite low and you may need to shield it from sunlight so that it can be properly observed.

By the way, this circuit is somewhat similar to the neon test screwdrivers that are sometimes used to test for mains voltages around power points and light switches. Do not, under any circumstances, use the Mini Electric Fence Tester to check for mains voltages. It's not designed for this role.

Conversely, do not use a test screwdriver to check the operation of an electric fence. This is because they are not rated for electric fence voltages and the resistance in series with the neon indicator may break down. Once damaged, the test screwdriver could present a serious electric shock risk if it is then used on the mains supply.

Building it

Fig.2a shows the assembly details for the PC board (code 11303994, 45 x 20mm). Install the parts as shown and make some wire loops at each end for the contacts. We used paper clip wire for the loops and soldered this directly to the copper pads. Alternatively, you could use small screws and nuts to secure the wire in place. This latter method will ensure that the copper pads don't come adrift due to strain from the wire loops.

Once the assembly is complete, the PC board can be wrapped in some clear heatshrink tubing, leaving the wire loops exposed.

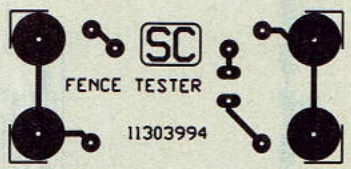
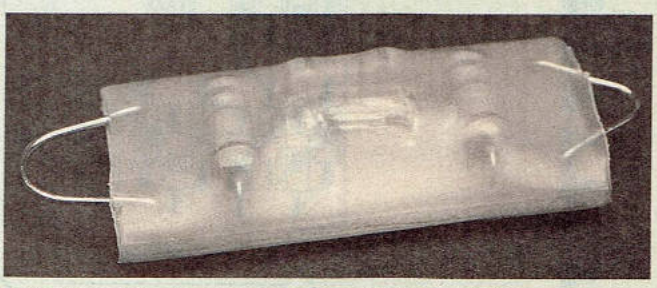


Fig.2a : you hardly need a PC board pattern as it is so simple – but here it is anyway!



It's not easy to see any components through the heatshrink but this photo gives an idea of construction.

Parts List

Mini Electric Fence Tester

1 PC board, code 11303994, 45 x 20mm
1 neon indicator, pigtail type
1 80mm length of 1mm diameter tinned copper wire or paper clip
3 330kΩ 1W resistors
1 45mm length of 25mm diameter clear heatshrink tubing

"Midi" Electric Fence Voltage Tester

The Midi Electric Fence Voltage Tester is a slightly more elaborate instrument than the Mini Tester. It also uses a neon indicator but in this case the fence voltage can be read off a calibrated scale after adjusting a single control knob.

As shown in the photo, the unit is housed in a small plastic case and a small hole in the front panel allows the neon indicator light to be seen when it flashes. As before, the light output is quite low and you need to watch closely to see the flash.

Fig.3 shows the circuit details. It's really very simple and consists of a voltage divider and the neon indicator itself. In operation, the electric fence voltage is applied to a series string of 19 10kΩ resistors which in turn feed a 10kΩ potentiometer (VR1). The divided voltage is then tapped off from VR1's wiper. Why use so many 10kΩ resistors? The answer is that they are necessary to provide a sufficient voltage rating for the divider, which could encounter fence voltages up to 10kV.

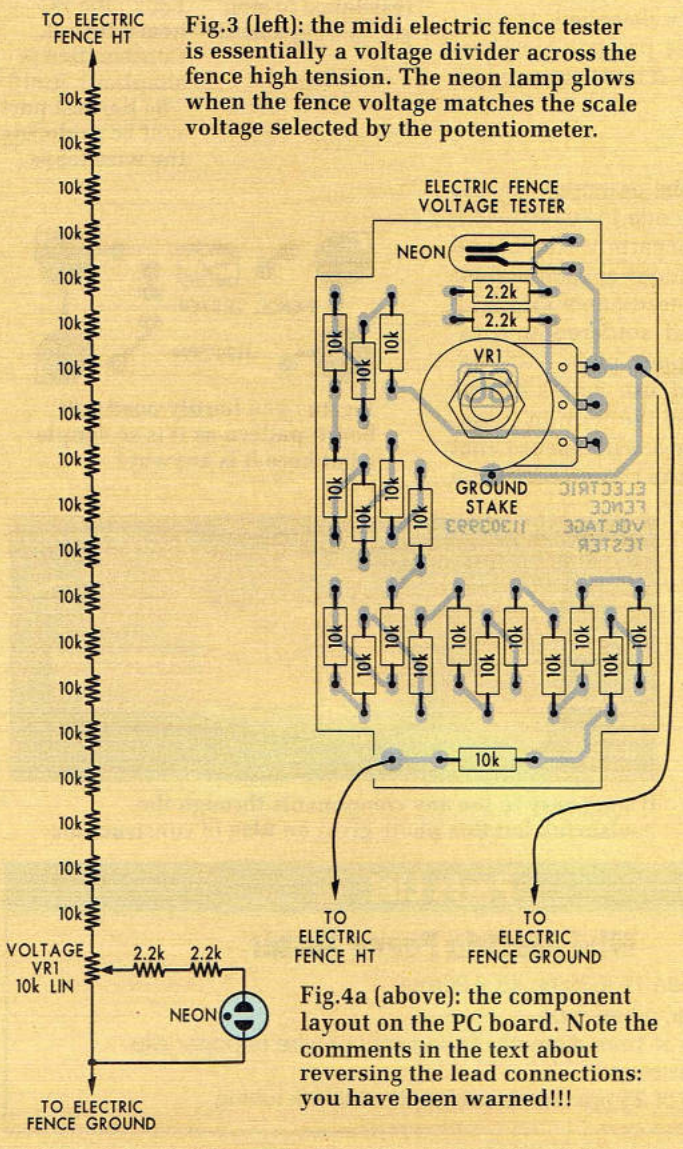


Fig.3 (left): the midi electric fence tester is essentially a voltage divider across the fence high tension. The neon lamp glows when the fence voltage matches the scale voltage selected by the potentiometer.

Fig.4a (above): the component layout on the PC board. Note the comments in the text about reversing the lead connections: you have been warned!!!

Housed in a small utility box, the midi electric fence tester is ideal for occasional testing. The probe is as used in a multimeter.

VR1's wiper applies the divided voltage to the neon indicator via two 2.2kΩ resistors, while the common side of the circuit is connected to the ground stake on the electric fence.

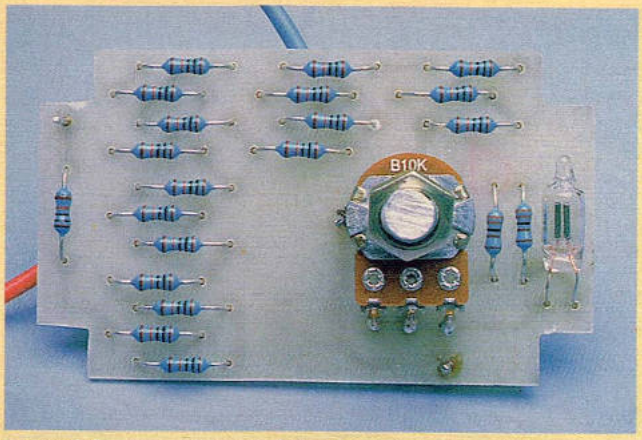
A neon indicator will light when the voltage across it reaches about 90V and so we use this characteristic to calibrate the potentiometer (VR1). If the wiper is wound fully towards the 10kΩ resistors, then the divider ratio is such that the neon will flash when there is 1.8kV on the electric fence. Conversely, as VR1 is wound towards ground, the division ratio increases and so the input voltage from the fence needs to be higher than 1.8kV in order to light the neon indicator.

Let's say, for example, that VR1 is set to its mid-position. In that case, the fence voltage needs to be at least 3.6kV to make the indicator flash.

One small complication with this circuit is that it will not produce reliable results unless the body of the potentiometer is well grounded.

If this isn't done, the neon indicator conducts the fast rise-time fence voltage into the air and hence shows a small flash, even if the pot is wound fully down.

Although the pot body is grounded on the board via a PC stake (and ultimately to the fence ground), the inductance of the ground lead is enough to cause problems with fast rise-time voltages. For this reason, we have specified a metal knob for the pot so that it can also be grounded via your body. In practice, this means that measurements must be made with your hand holding the metal knob, to



99% of the assembly work in this project is soldering resistors! Fortunately, most are the same value.

prevent false readings from occurring.

When using the tester, the pot is initially wound fully clockwise and gradually backed off until the neon indicator just begins to flash. The fence voltage can then be read directly off the scale.

Note that the overall resistance of this tester is 200kΩ, so it shouldn't load down the fence voltage to any measurable degree.

Building it

Fig.4a shows the assembly details for this fence tester. It's built on a PC board coded 11303993 and measuring 77 x 47mm. Start the assembly by soldering in all the resistors, then install PC stakes at the fence and ground inputs, at the three pot terminal positions and at the ground position for the pot's body.

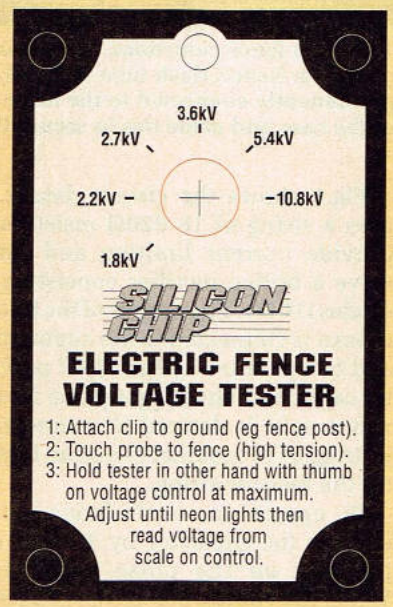
The potentiometer can now be installed by soldering its terminals to the PC stakes and by soldering its body directly to the adjacent ground stake. You will need to scrape away some of the plating from the pot body near the PC stake, using a file or sharp knife, so that it can be soldered easily. The neon indicator has its leads bent at right angles before being soldered into position. It can be secured to the board with a dob of silicone sealant.

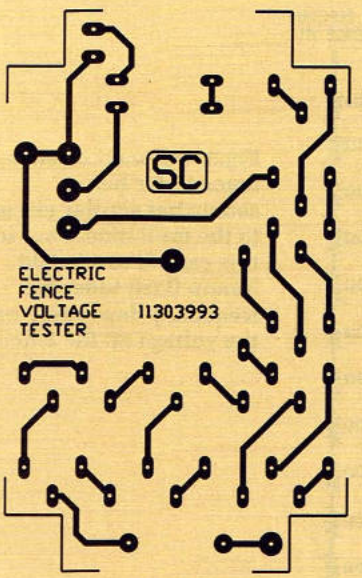
The next step is to attach the front panel label to the lid of the case and drill the holes for the pot shaft and for viewing the neon indicator. You will also need to drill two small holes in the sides of the case for the external leads. These holes should be fitted with small rubber grommets.

The pot shaft can now be trimmed to suit the knob, after which the PC board assembly can be mounted on the lid and secured using the pot nut. When fitting the knob, rotate the pot shaft fully clockwise, then tighten the grub-screw with the pointer towards the 10.8kV position.

This done, feed the external leads through the grommets and solder them to the PC board. These leads should have good insulation to prevent any voltage breakdown between them. Use a green or black alligator clip for the earth wire connection and a red insulated probe for the fence terminal. This will prevent any confusion when you are making the connections to the electric fence.

Warning! – if you reverse the connections to this tester, the body of the pot and hence the knob will be at the fence voltage. If the fence is working correctly, this means that you will get a nasty belt as soon as you touch the knob. Get the connections the right way around and you won't have any problems.


3.6kV
2.7kV
5.4kV
2.2kV
10.8kV
1.8kV
SILICON CHIP
ELECTRIC FENCE VOLTAGE TESTER
1: Attach clip to ground (eg fence post).
2: Touch probe to fence (high tension).
3: Hold tester in other hand with thumb on voltage control at maximum. Adjust until neon lights then read voltage from scale on control.



Figs 4b & 4c: the front panel and PC board artwork, reproduced same size for those who wish to make their own.

Parts List

Midi Electric Fence Tester

1 plastic case, 82 x 54 x 30mm
1 PC board coded 11303993, 77 x 47mm
1 front panel, 80 x 52mm
1 neon indicator, pigtail type
2 small rubber grommets
6 PC stakes
1 10kΩ 16mm pot. (VR1)
1 black or green aligator clip
1 red instrument probe
1 metal knob
1 1m length of blue or black 250VAC rated wire
1 1m length of red 250VAC rated wire
19 10kΩ 0.5W 1% metal film resistors
2 2.2kΩ 0.5W 1% metal film resistors

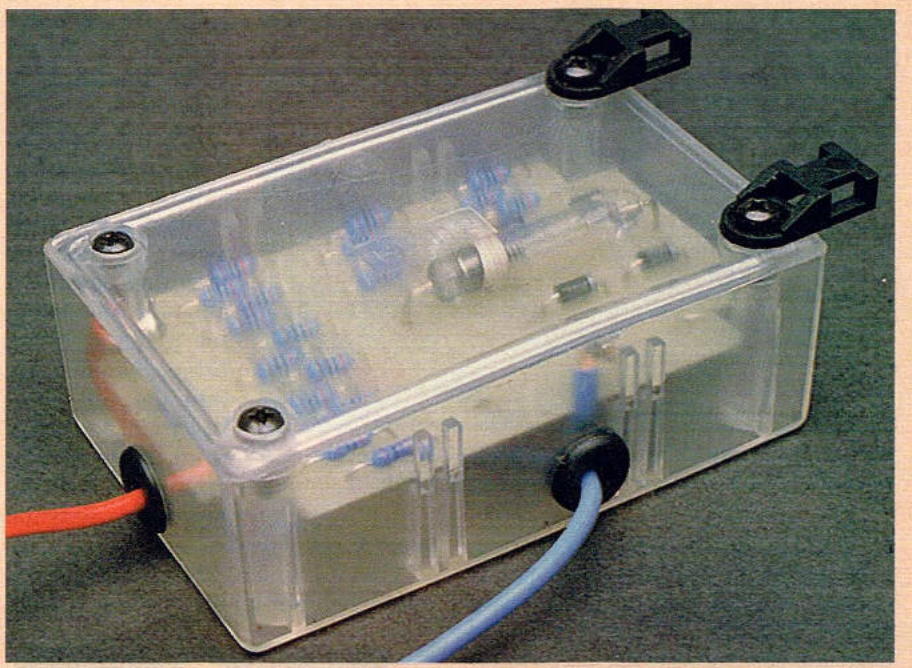
"Maxi" Electric Fence Voltage Tester

Unlike the other two testers, the Maxi Electric Fence Tester uses a high-brightness xenon flash tube although the circuit is only slightly more complicated than before.

It uses an internal capacitor to store up some charge from each fence pulse and when this reaches a critical level, the xenon tube emits a bright flash.

This cycle is then repeated, with the tube flashing at regular intervals if the fence is operating correctly.

As shown in the photos, the unit is housed in a clear plastic case and is designed to be permanently attached to the fence.



The maxi fence controller, housed in a see-through and weatherproof plastic case. The Xenon flash tube is clearly visible through the case so this can be left permanently connected to the fence. We used the small plastic clips on the top of the case and cable ties to secure this tester to a suitable fence post.

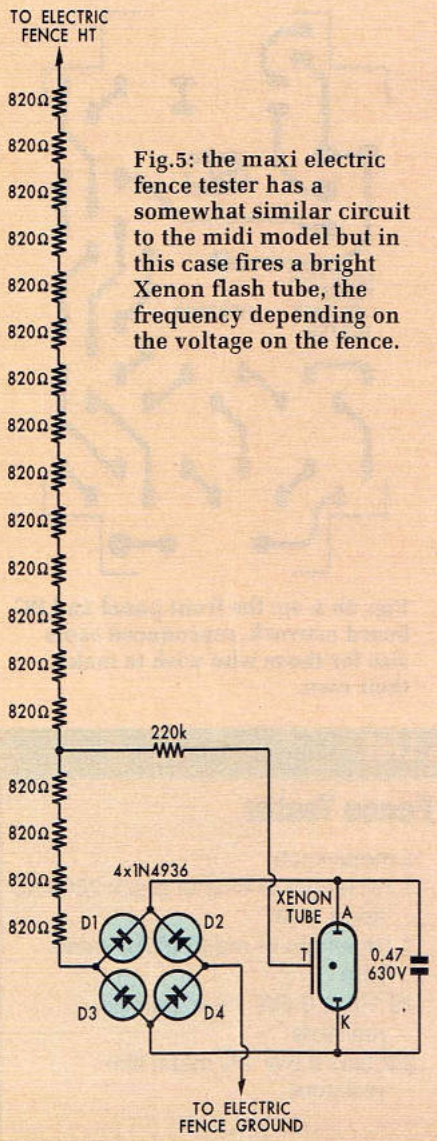


Fig.5: the maxi electric fence tester has a somewhat similar circuit to the midi model but in this case fires a bright Xenon flash tube, the frequency depending on the voltage on the fence.

Fig.5 shows the circuit details. It uses a string of 18 820Ω resistors to provide current limiting and these drive a bridge rectifier consisting of diodes D1-D4. The output of the bridge in turn is connected to the xenon tube and to a parallel 0.47µF 630V polyester capacitor. The trigger pulse for the xenon tube is derived by connecting its trigger (T) terminal to a point higher up the resistor string.

In operation, each fence pulse charges the capacitor by 10-40V, depending on the pulse amplitude. When the voltage across the capacitor reaches 200-300V, the xenon tube is ready to fire. It then fires when the next fence pulse takes the trigger input sufficiently high.

When the xenon tube fires, the 0.47µF capacitor quickly discharges. The capacitor now recharges on each successive electric fence pulse until the breakover voltage of the xenon tube is reached again.

The flash rate depends on the fence voltage. The circuit draws about 0.5mJ per pulse from the electric fence which does not affect normal operation. This is why the circuit can be left permanently connected to the fence.

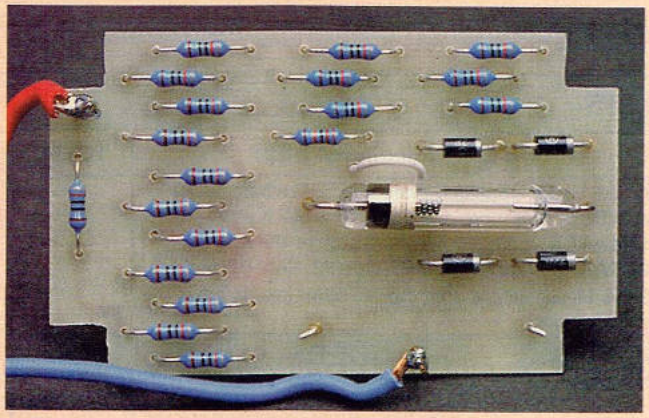
Building it

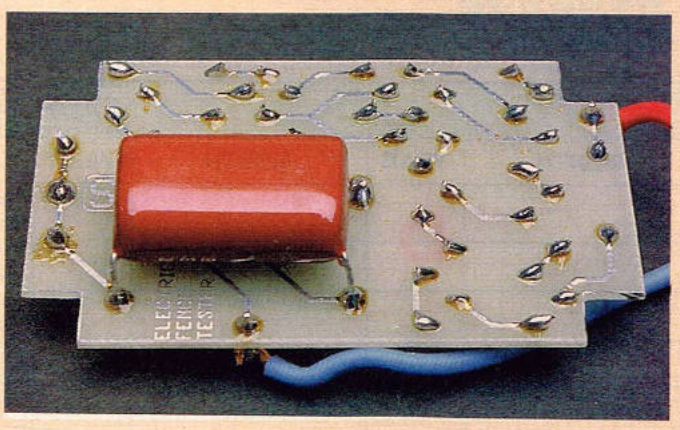
A PC board coded 11303992 and measuring 77 x 47mm accommodates all the parts – see Fig.6a. Begin by installing PC stakes at the two external wiring positions, then fit the resistors and diodes. Make sure the diodes (D1-D4) are all correctly oriented.

The capacitor is installed on the copper side of the PC board. Bend its leads at right angles so that the body of the capacitor can lie flat against the board before soldering it into position (see photo). This is necessary to allow the PC board assembly to fit into the specified case.

The leads of the xenon tube must also be bent at right angles before mounting it on the board. Use needle-nose pliers to hold the leads adjacent to the glass body before bending them – if you don't do this, you could crack the glass tube. This done, solder the tube into position and don't forget the trigger lead.

You will need to drill two holes in the sides of the case for the external leads. Fit these holes with rubber





Front (above) and rear (right) views of the completed PC board. Note that the 0.47µF discharge capacitor attaches to the copper side of the board.

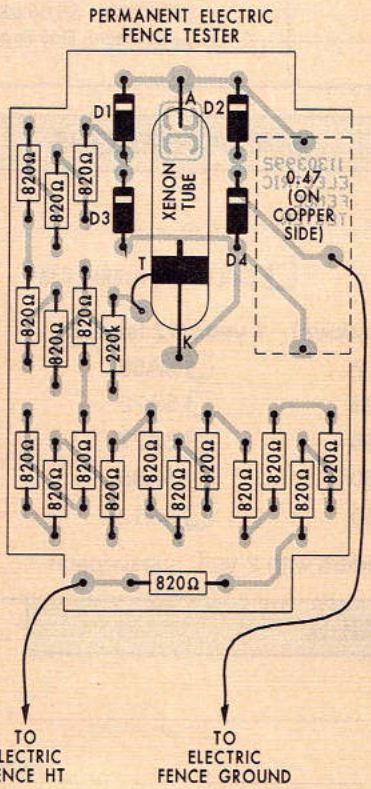
grommets, then pass the leads through and solder them to their respective PC stakes on the PC board. It's a good idea to use a red lead for the HT connection to the fence and a blue or green lead for the fence ground connection. As with the previous design, these leads should have good insulation, to prevent any high-voltage leakage between them.

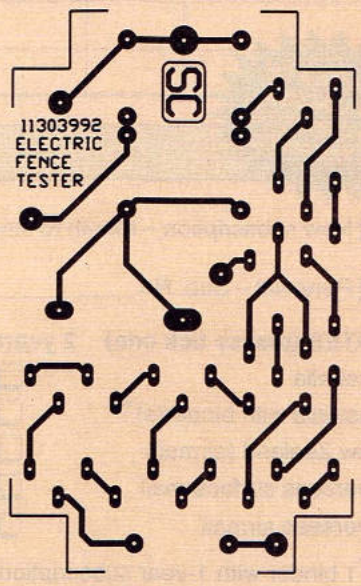
The PC board is designed to clip into the case against the integral side pillars. If necessary, you can lightly file the sides of the PC board so that it is a neat fit.

Because it will be exposed to the weather, it's necessary to seal the wire entry holes and the case lid using silicone sealant. Before doing this, however, it's a good idea to test the circuit to make sure it works correctly. That way, if you do have a fault, you can easily remove the board from the case and check for missed or bad solder joints, or incorrect component placement.

Finally, you will have to figure out some way to mount this unit. This may involve fashioning a suitable clamp or you can do what we did and fit a couple of small plastic clips so that the unit can be tied to a convenient fence post using tie-wire.

The HT lead can be attached to the electric fence using a suitable electric fence joiner, while the ground lead can be attached directly to a ground stake. SC





Figs 6a & b: follow the PC board overlay (left) and you should have no problems assembling the board. The full-size PC board pattern above can be used to etch your own board or to check commercial boards before assembly.

Parts List

Maxi Electric Fence Tester

- 1 clear plastic plastic case, 82 x 54 x 30mm
- 1 PC board, code 11303992, 77 x 47mm
- 1 straight 32mm-long xenon flashtube
- 2 fence clips
- 2 PC stakes
- 1 1m length of green or blue 250VAC rated wire
- 1 1m length of red 250VAC rated wire
- 2 electric fence wire joiners
- 4 1N4936 1A fast diodes (D1-D4)
- 1 0.47µF 630V polyester capacitor
- 1 220kΩ 0.5W 1% metal film resistor
- 18 820Ω 0.5W 1% metal film resistors

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NEW Z99

See Cat P47 for full details.
Cat XC-5020.

$299

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NEW Z99

They're back ! We have secured a small quantity of this fantastic speaker. Ideal for midrange and PA widerange. Specifications Impedance 8Ω, power handling 10WRMS, frequency response 80-17kHz. Sold for $21.50 in 1987!!

Cat. CE-2315 **$22.95**

New Catalogue Last Month

Send $2 and we"ll post you one.

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Automatic 240V Backup Power Supplies

NEW Z99

These Line-interactive automatic backup supplies are *sometimes incorrectly called Uninteruptable Power Supplies (UPS) ours are designed for personal computers (Apple, IBM PC etc), and are available in two different sizes - 400VA and 800VA. The ABS basically consists of a 240VAC inverter which is powered from a battery when the power fails. The batteries are of the Sealed Lead Acid type (SLA). Switchover from mains power to backup power is automatic (<4ms) and does not require user intervention. Software requires a spare COM port and IRQ to function. An average system will stay powered approx. 4 minutes for 400VA model, and 10 minutes on 800VA - usually enough time to save work and close Windows normally.

400VA Cat. MP-3095 **$249**
800VA Cat. MP-3096 **$399**

STAINLESS STEEL FASTENERS BARGAIN PACK

NEW Z99

You may never buy a machine screw or bolt again ! We purchased a whole factory load of goods last year. Most of the stuff was electronic and it has been offered to you already. We even exported some of the stock. In some ways we left the best offer of the lot until last. Included in the buy was over 3 tonnes of high grade stainless steel metal thread screws and bolts. We have finally got around to sorting them and have decided to make a fastener pack to end all packs.

WHAT YOU GET (inside the outer pack)

SUBPACK #1 This consists of over 600 (yes, 600) metal thread screws . They range from about 2mm in diameter to 5mm in diameter 6-25mm long. Most are metric thread, some UNF, Posidrive, Phillips, UNBRAKO-type & countersunk slotted. Almost all are 304 or 316 grade stainless steel. Some may be other S/S grade.

SUBPACK #2 This consists of around 100 metal threaded bolts from about 5mm dia to 8mm dia, from 8 - 45mm long. Once again most are metric thread but some are UFC & UNC. Heads range from Unbrako, countersunk, hex, pan type with Phillips, Posidrive or hex drive.

SUBPACK #3 This pack consists of bolts 8 - 15mm dia, UNBRAKO or hex heads, 6 pcs approx.

SUBPACK #4 A bag of over 100 nuts & washers. Sizes range from the very small to very large, metric, UNF & UNC. Most washers are 316 metric grade stainless.

Please note: We have described the contents above in terms of "packs". The actual bag will contain all of the hardware described above, but the parts may be mixed together.

BONUS We'll also chuck in a monster bolt, 15 to 25mm in diameter! The pack weighs almost 3kg!

Cat. HP-0480 **$29.95**

HEY! OVER 800 PARTS AT LESS THAN 4 CENTS A PIECE!!

Post & Pack, normal rates + $5 due to extra weight

200W Active Subwoofer Amplifier Module With Remote Control

NEW Z99

Power output 200W RMS/4Ω, 150W RMS/8Ω. See catalogue page 52 for full details.
Cat. AA-0505

May $399

TRANSISTOR SPECIAL

NEW Z99

2N-3440 Pack of 10

Specifications:
•250V 1AMP NPN Switching / Driver Transistor
•Rugged TO-39 metal case (similar to TO-5)
•Full data specs included
Cat. ZT-2296

$6.50 Pkt 10

CAT 5 CROSSOVER PATCH LEAD

2 metre Cat 5 patch lead with wiring crossed over. Black in colour. RJ45 to RJ45

NEW Z99

Cat. YN-8172 **$12.95**

NEW JAYCAR STORE IN MELBOURNE

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PH: 03 9870 9053 FAX: 03 9870 2598

VULKAN 100 Gas Soldering Iron

Portable soldering. The Vulkan uses butane gas and is temperature adjustable (equivalent to 10 - 60 watts). It fills in 20 seconds and has up to 90 minutes continuous use fuel capacity. Supplied with a safety cap, which includes flint for igniting tool.
Cat. TS-1250

$49.95

MADE IN IRELAND

VULKAN 100 Soldering Tool Kit

This kit includes the same soldering tool. The accessories supplied in the kit give it a much larger range of uses.
Kit includes: •Soldering tool, safety cap with flint ignition and 2.4mm soldering tip •Flame torch tip •5mm hot air tip •Hot knife tip •Aluminium tray with wetting sponge •Aluminium tray for hot tips etc •Carry case with locking clip, powder coated steel.

NEW Z99

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Cat. TS-1260

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L.C.D. Panel Meter

NEW '99

•Snap retaining into panel •Shallow depth •User selectable decimal point •0.1" launcher connections •+9V single rail power

Cat. QP-5570 **$25**

L.E.D. Panel Meter

NEW '99

•Surface mount construction for reliability •0.1" launcher connections •Brightness matched LEDs •Superbright LEDs •Attractive bezel with mounting clips •5V powered, TTL compatible Cat. QP-5580 **$25**

Extremely Large Digital Clock with Humidity, Temperature & Calendar

NEW '99

Ideal for office, factories, homes, wine cellars etc. Includes: •Humidity sensor •Temp. in °C and °F •Calendar with day, date and month •Huge display 146(w) x 95(H) •Overall size 210(W) x 210(H) x 25(D)mm. Cream and silver in colour, operates on 2 AA batteries (not supplied) Cat. XC-0232 **Was $99.95 May $79.95 Save $20**

Wireless Remote Control Extender

Ingenious device for extending the transmitting range of your infrared remote-controlled appliances in the home or office. Infrared commands from your remote control are transmitted by UHF (radio signal) to the receiver in another room - where they are converted back to infra red for the device(s) you want to control. Ideal for situations where you have a VCR playing in one room, and you watch the TV in another. Cat. AR-1805

NEW '99

$119.00 SEE 99 CAT PAGE 221 FOR SPECS.

Wireless Audio and Video Transmitter / Receiver

Use a wireless CCD camera setup!

NEW '99

WATCH CABLE TV ALL OVER THE HOUSE!

CCD CAMERA COMPATIBLE

The transmitter can transmit the audio/video signals from a VCR, TV set, LD, Sat receiver.... to the distant receiver, which is connected to another TV or VCR. You can also use the transmitter and receiver to send the picture from a camcorder or CCD camera to a TV. Range up to 100m (line of sight). Cat. AR-1800

$299.50 SEE 99 CAT PAGE 221 FOR SPECS.

EASY START CAR JUMP CHARGER

NEW '99

This device works via cigarette lighter sockets. It takes some charge from the good battery, and gives it to the bad battery. 5 mins min. time required.

WAS $39.95 IN 1998

May $20

Cat. MB-3595

Economy Aluminium Attache Case

This case is more like a typical aluminium servicemans case. It is all silver and is supplied with a tool pallet which sits in the lid and will hold an assortment of tools. The case is supplied with 5 adjustable dividers, is padded and lockable and supplied with 2 keys. Size: 450(W) x 320(H) x 145(D)mm. Cat. HB-6352

Was $59.95 May $49.95 Save $10

POLYCARBONATE CASE BARGAIN

We have a limited quantity of these cases available at less than half price. Size 95 (L) x 48 (W) x 38(H)mm. Colour light grey. Normal price is be about $5.50 **$2.50**ea Cat. HB-5620

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When your clients see you with this they'll expect a bigger bill! When we first saw this case it was loaded with tools for "computer repairs" Externally the case is finished in a durable dark green cloth. A shoulder strap is included & you will be pleased with the smooth carry handle. A classy product. Size (internal) 380x265x60mm deep approx Cat. HB-6370

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Flexi-light has a 240mm flexible "gooseneck" which will stay in whatever position you bend it. On the end is a small globe and a mirror. The mirror measures approx. 50 x 25mm. The globe is powered by 2 x AA batteries (not supplied).

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May $11.95 Cat. ST-3008

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		Was	May	Save
Cat. SB-2545	AC675E PKT 4.	$4.20	$3.00	$1.20
Cat. SB-2546	S13E PKT 6.	$9.75	$7.00	$2.75
Cat. SB-2547	E312E PKT 6.	$4.20	$3.50	$0.70
Cat. SB-2548	AC13E PKT 4.	$4.20	$3.00	$1.20

Computer Lead

SCSI 2 Centronics 50 Male to Centronics 50 Male

•Thick cable. •600mm long. Cat. PL-0958

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Passive Infra Red & Microwave In 1

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15m for hallway or warehouse Cat. LA-5013

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Pack 'N' Latch

Sellout

See 98 Cat. page 108 for details. Cat. HB-6322

Was $39.95 May $29.95

Save $10 LTD QTY AVAILABLE

Colour Pattern Generator Kit

Sellout

See page 13 of 1998 Catalogue for details. Cat. KC-5224

Was $149.50

May $110.00

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12V DC 2 Amp Regulated Power Supply

Ideal for workshop use where exactly 12V DC is required regardless of the current drawn. DC connection by banana plugs or screw terminals. Size 180(L) x 75(W) x 65(H)mm excluding output terminals. Cat. MP-3017

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Cat. CS-2268

CD STEREO HEADPHONES

Grab some new headphones & save!
NORMALLY $32.95
MAY ONLY $20Pr
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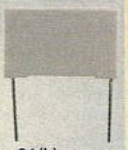
Memokey 20 Second Recorder

Memokey is a keyring which will record messages digitally, up to 20 seconds long. Three messages can be recorded. Uses four G13 batteries (supplied). Supplied with chain and keyring. Cat. XC-0275
Was $24.95 Save $6.95
May $18.00

2.0uf 250VDC Cap

NEW '99



Our normal price for these is $2.25 each. We've made a bulk surplus deal, and can offer these at well below normal price. They are white in colour, size 31(L) x 10.5(W) x 20(H)mm. Lead spacing 27mm, lead length 18mm.
Cat. RG-5176 Pkt 10 **$7.95**
Cat. RG-5177 Pkt 100 **$59**

COMPUTER MICROPHONE HEADSET

WAS $19.95
THEN $14.95
MAY $9.00 Cat. AA-2028

Indoor / Outdoor Thermometer with Memory & Alarm

This thermometer has 3 LCD displays - the top one is the time, then the indoor temperature and the outdoor temperature. The memory records the highest and lowest temperature and the alarm is settable to sound when a predetermined high and low temperature is reached.
Cat. QM-7212
NORMALLY $37.95
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MAY $27.95

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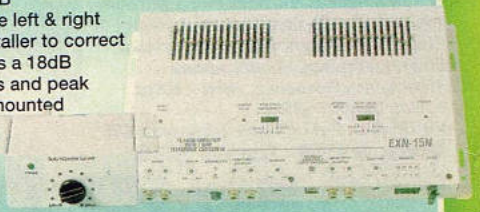

WITH 2 WAY CROSSOVER AND REMOTE SUB VOLUME CONTROL. This unit has 15 separate left & right adjustments starting at 25Hz allowing the installer to correct any unwanted peaks and dips. It also includes a 18dB Octave crossover, input and out level controls and peak indicators, a delay turn on option, and dash mounted remote sub woofer level control. Its low profile would allow installation under a seat
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This torch includes a 6V 5AH sealed lead acid lantern battery, and a 240V 500mA charger, which automatically switches off when the unit is charged. A great way to have a long life torch for when you go bush next. And if you are going away for an extended period take an extra battery, or use a solar panel to charge them. The 2 alligator clips supplied will need to be soldered to the charger output leads for battery connection when charging.
SEPARATE COMPONENTS COST $80
SET IS NORMALLY $59.95
MAY $45 SAVE $14.95 Cat. ST-3081

Multifunction Electrical & Electronic Tester

This Hi Tech advanced tester allows you to safely, quickly and accurately check for the following: •AC Voltage Test •DC Voltage Test - 1.5 to 250V •Continuity Test - 0 to 100MΩ. •Polarity Check •Electronic Component Test •Hi/Low Sensitivity Switch •Built-in Self Test •Safe - No current flows through ones body. •See cat page 32 for full details. Cat. QP-2260
Was $17.95 Save $5 Now $12.95

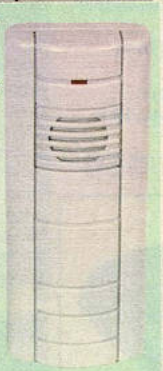
CD TO CASSETTE ADAPTOR

Play a CD player through the car cassette player. Cat. AR-1760
Normally $19.95
MAY $12
Save $7.95

T Case Bargain

High quality instrument case. Grey in colour. 230(H) x 120(W) x 90(D)mm.
Limited qty at this price.
Was $24.95 Save $14.95
May Only $10
Cat. HB-6514

Door / Window Entry Chime

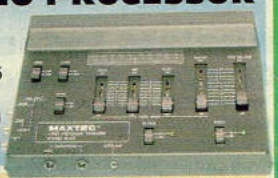


Now you can be notified whenever a door or window is opened with a pleasant sounding chime. The chime unit itself is powered by a single 9V battery and triggered using a reed/magnet assembly. Reed switches are incorporated on both sides of the chime for left or right hand magnet triggering.
NORMALLY $14.95
MAY $9.95
SAVE $5 Cat. LA-5168

POCKET SHIFTER MULTITOOL

Cat. TH-1905
See 98 Cat. page 120.
Was $19.95
Then $14.95
May $10

AUDIO/VIDEO PROCESSOR



WITH ENHANCER & MIXER See Cat P227 for details. Cat. AV-6415
WAS $149.50
MAY $109.50
Save $40

A4 Laminating Machine

Protect and preserve your favourite documents, photos, catalogues, recipes etc etc up to A4 size (216 x 303mm). Laminated items are then protected in a waterproof airtight seal. So simple to use. Operates on 240VAC.
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MAY $169
SAVE $30
Cat. XL-2510
A4 Laminating Sleeves
Cat. XL-2512 Pack of 25
$12.95

Magnifier on Flexible Stand

This all purpose magnifier has a diecast base (80mm dia.), a flexible gooseneck (130mm long) and a powerful magnifier with a diameter of 62mm. Its ideal for work bench use, and makes reading components dead easy. NORMALLY $19.95
HALF PRICE FOR MAY ONLY $10 Cat. QM-3530

AUDIO SIGNAL GENERATOR

The QT-2300 has the following features:
•high frequency stability
•excellent stability on range changes
•frequency range from 10Hz to 1MHz in five ranges
•more than 5VRMS at no load and more than 2.8VRMS on 600 ohm loading (sine wave)
•synchronising input terminal
For full details see catalog P35
NORMALLY $269
MAY $199 SAVE $70 Cat. QT-2300

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OVERNIGHT DELIVERY

SUPERSONIC MOTH REPELLER

Do you have moths eating your clothes in the wardrobe or flying around the pantry. This moth repeller provides the most effective way of keeping these pests away without using chemicals and poisons. Try one and see for yourself. Requires 9V battery.

Normally $29.95 Cat. YS-5530

May $14.95 Half Price

Digital Thermometer

With Min / Max Day Date, Memory & Time

This thermometer displays the time (24 hour mode) and inside and outside temperatures in its normal mode. It has a memory which holds the maximum and minimum temperatures reached and the time this happened. Temperature range is -39.9° to +49.9°C. Outside temperature probe is on 2 metres of cable. Cat. QM-7210

Normally $34.95

Save $10 **May $24.95**

Walk-By Safety/Security Light

This is a portable light which uses a PIR detector to activate the inbuilt light from 5 to 30 seconds after movement has been detected. The unit can be battery powered using a 6V DC mains adaptor, MP-3016. Cat. LA-5140

SAVE $14.95 NORMALLY $29.95

HALF PRICE $15.00

4G BLACK CAR STEREO POWER CABLE GIVEAWAY

This is slightly small in diameter and copper content than our normal cable. Save a fortune. Normal stuff is $6.95m Cat. WH-3076

Only $2.95 metre

$130 per 50 metre Roll

INTERNET PHONE!

Cat. XC-5100

Was $24.95

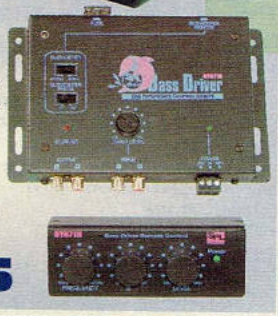
Save $8

May $16.95

Bass Driver with Remote Control

Installed in the signal line from the head unit to amplifier, the bass driver provides the listener with dash mounted control of crossover frequency, sub woofer level and equalisation. Specifications

- Frequency Response: 40Hz - 400hz
- Level Control: ±18dB
- Q Control: 2-20 • Phase Selector:0°/180°



Was $129 Save $44

Cat. AA-0426 **May $85**

VISITOR CHIME

When a person walks past, visitor chime goes "Ding Dong". Sensing distance is 5 metres. Battery operated.

Was $29.95

Save $9.95 **May $20**

Cat LA-5010

HOBBY MOTORS BARGAINS

Two models available. Ideal for hobbyist, experimenters, robotics, replacement, etc.

Torque	Low	Medium
Operating Volts	1.5-4.5V	1.5-4.5V
Nominal Volts	3V	4.5V
Speed (no load)	12000rpm	12500rpm
Current (no load)	0.28A	0.25A
Speed (max eff)	8540rpm	9560rpm
Current (max eff)	0.69A	0.81A
Torque (max eff)	7.94gcm	17.86gcm
Size dia	20mm	23.6mm
Size length	25mm	25mm
Shaft length	8.1mm	6.5mm
Shaft dia	2mm	2mm

LOW YM-2706

NORMALLY $2.50ea MAY $1.50ea

BUY 10 FOR $12 BUY 100 FOR $90

MEDIUM YM-2707

NORMALLY $3.25ea MAY $2ea

BUY 10 FOR $16 BUY100 FOR $130

NASHUA GAFFER TAPE

40 Metre rolls. 50mm Wide.

Normally $22.50 Roll

May $17.50 Roll

Save $5

Black - Cat NM-2812

Silver - Cat NM-2814

44MM PRO RACK CASE SALE

Our supplier sent us too many! Your chance to save a packet. See CAT P122 for details.

NORMALLY $69.95

MAY $49.95 Save $20 Cat. HB-5120

Inductance DMM

SAVE $20

- Capacitance
- Temperature
- Transistor Test
- 3.5 Digit / 1999 Count
- Continuity Buzzer
- Diode Test
- Holster Included
- Carry Bag Included

Cat. QM-1480

Was $109.50

May $89.50

6 Way Power Outlet With Mains Filter

Not only is it a six way power board, it incorporates:

•VOLTAGE SURGE PROTECTION •NOISE REJECTION FILTER NETWORK •SPIKE PROTECTION •SAFETY CIRCUIT BREAKER. Ideal for running your computer gear, telephone, fax, answering machines, Hi Fi, video and TV equipment. Cat. MS-4030

Catalogue Price $36.95 May $30

Emergency Socket Tool - Multi Sizing

This innovative socket suits 3/8" drivers, and will automatically adjust to nuts and bolts up to 21mm or 13/16". Really only suitable for medium to light work but can save anguish when all you NEED is a socket - and all you've got is a shifter. Cat. TH-1908

Was $12.95 May $8.00

Wireless Indoor / Outdoor Thermometer

This fantastic new product will support up to three remote sensors which can be placed anywhere you like and transmit to the main unit which is usually mounted in the house. The main unit features a high/low alarm for every sensor, min/max reading with a temperature range of -5°C to 50°C. The remote sensors are splash proof and have their own digital temperature display and can transmit up to 30m. (Main unit supplied with one sensor). Cat. QM-7220

Normally $99 Save $20 May $79

Cat. QM-7221

EXTRA REMOTE SENSORS **$39.95**

Magnetic Metal Dish

Holds small parts magnetically. Cat. TH-1970

Was $10.95

Save $4

MAY $6.95

Electronic Tester - Metal Locator

Pocket tester that includes a metal locator!!! Find cables and water pipes etc from behind walls. Also checks AC Voltage, continuity DC polarity and microwave oven leak detector. Cat. QP-2270

WAS $17.95 MAY $13.95 SAVE $4

Book Bargains

Troubleshoot Your Computer

Was $21.95

MAY $11.95

Save $10 Cat BB-7441

306 Elector Circuits

Was $28.95

MAY $18.95

Save $10 Cat BM-2476

Sound IC Data & Substitutions

Was $29.95

MAY $19.95

Save $10 Cat BM-4588

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

TALKING IN/OUT THERMOMETER

See 98 Cat. P204 for details. Cat. QM-7215

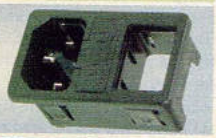
Was $34.95 Save $10

May $24.95

IEC Socket / Switch

Was $5.95 May $3.95

Save $2.00 Cat. PP-4003



SPEND $50 IN ANY JAYCAR STORE AND ASK FOR YOUR FREE VERNIER CALIPERS

VALUE $4.95

NOT AVAILABLE AT DEALERS

Cat. TD-2080

25MHz Dual Trace CRO

See 98 Cat. P28 for full details.

Cat. QC-1900

Was $749

Save $150

May $599

INCLUDES 2 PROBES

NEW - ANTISTATIC PRODUCTS

Desk Mat $19.95 Cat. TH-1783

Large Desk Mat $39.50 Cat. TH-1784

Floor Mat $149.00 Cat. TH-1786

Field Service Mat/Bag $39.95 Cat. TH-1776

GROUNDING CABLES

Desk Cat TH-1791 **$9.95**

Floor Mat Cat TH-1790 **$9.95**

Desk Mat to Floor Mat $9.95 Cat. TH-1792

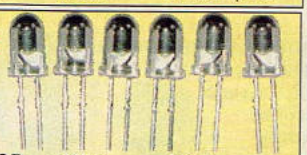
3mm LED Bargains

Great Value

Cat	Description	MCD	Was	Now
ZD-1752	Red Waterclear	120	$0.65	**10 for $2**
ZD-1753	Red Waterclear	900	$1.00	**10 for $5**
ZD-1754	Yellow Waterclear	2000	$1.65	**10 for $6**
ZD-1755	Green Waterclear	350	$1.25	**10 for $4**
ZD-1756	Blue Waterclear	500	$3.95	**5 for $10**

5mm LED Bargains

Great Value



Cat	Description	MCD	Was	Now
ZD-1784	Green	2200	$6.95	**5 for $12**
ZD-1787	White	1800	$7.95	**5 for $15**

1 Farad Stiffening Capacitor and Digital Display

Limited quantity available. Not from Dealers. See 1998 Catalogue, P64.

Capacitor Cat. RU-6750 **$199**

Display Cat. RU-6751 **$119**

$318

Buy Both $299 Save $89

The Ultimate "Swiss Army" Gadget?

It is made of stainless steel and is well finished. The main tool is an electrical type plier. It has a stainless steel belt clip, 3 "Swiss Army" type knives, Philips screwdriver, bottle opener, file saws, fish scaler, sharp knife, ruler, slotted driver, sinker fixer, small hex spanner, etc., etc. Also included is a sturdy woven carry cover with belt and loop. Limited quantity. Cat. TH-1902

Was $39.95 Save $12 Now $27.95

RESPONSE 2" Dome Midrange

This dome midrange has a 50mm fabric dome that is lightly coated with a "semi wet" compound and features an extremely smooth frequency response right up to 10K. As used in our JC50 Speaker Kit. Specifications: •Nom impedance: 6 ohms •Power handling: 100watts rms system power (using sample X-over) •Freq range: 326Hz - 10,000Hz •Sensitivity: 89dB 1watt 1metre. Cat. CM-2092

Normally $69.50 May $49.50 Save $20

Introduction to Loudspeaker Design

NEW 99

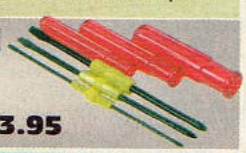
This new book is written for hobbyists, students, technicians and engineers seeking an overview of the technology of loudspeakers. A total chapter is devoted to crossover design. The appendices contain technical references, design aids and a chart depicting 18 different speaker enclosure types.

Chapter headings are:•Audio Basics •Loudspeaker Basics •Advanced loudspeaker topics •Enclosure design and construction•Crossover Design•Driver parameter measurement •Frequently asked questions •Softcover - 166 pages - 210 x 137mm

Cat. BA-1480 **$39.95**

3 PCE REVERSABLE SCREWDRIVER SET

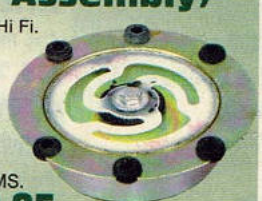
3 Philips and 3 slotted. Cat. TD-2023



Was $9.95 Now $6 Save $3.95

Subsonic Actuator (Aura Shaker Motor Assembly)

Ideal for cars, home theatre & Hi Fi. These units are very similar to those fitted in some really up-market movie theatres.•Operating Frequency: Subsonic, Max force: 20 foot pounds •Rated power: 18 watts continuous RMS.



Cat. XC-1008 **$29.95**

Security Screwdrivers

These specialist drivers are commonly called Snake or Pindrive or just security!

Cat.	Length	Tip Size
TD-2072	165mm	M1.7
TD-2073	190mm	M2.0
TD-2074	190mm	M2.3
TD-2075	190mm	M2.6

All one low price **Was $6.95ea**

May $4.95ea Save $2

Flexible Shaft Screwdriver

Now you can access that screw/nut head in that remote corner.

Flexible shaft on driver bends through 120° ie over a right angle. Ratchet action for screwing/unscrewing. Head is standard hex to take all manner of screwdriver/nutdriver bits. Hollow handle stores bits. 330mm long overall. Cat. TD-2014

Was $9.95 Save $4

May $5.95

FREE CALL FOR PHONE ORDERS 1800 022 888

DON'T FORGET TO VISIT OUR WEB SITE: www.jaycar.com.au

OVERNIGHT DELIVERY

VIDEO CAT 5 BALUNS

NEW '99

These devices will simplify CCD cabling, and increase transmission distance without the need for video amplifiers. Twisted pair Cat 5 cable is low cost, and easy to install. Transmission distance is up to 600 metres for B/W and 300 metres for colour and 1200 metres for items with an amplifier circuit. They are passive & require no power.

Video Balun One is required for each end of the cable run. Input is via a BNC plug & output via RJ45s & reversed for the other end of the line. 2 required. Cat. QC-3422 **$59.95ea**

Audio / Video Balun Similar to the video unit, except this has 2 way audio as well. BNC socket for video and RCA sockets for audio. RJ45 for Cat 5 connections. 2 required. Supplied with RCA to BNC adaptor. Cat. QC-3424 **$89.95ea**

Wireless CCD Camera System

NEW '99

THIRD EYE

This versatile CCD system is wireless - it transmits audio and video on UHF up to 150 metres (line of sight) - less if there are walls to go through. Supplied in a strong and handy PLASTIC carry-case, all parts are provided so that you can be monitoring the vegie patch, baby's room, front door - anything! - in just a matter of minutes. The receiver unit has audio / video output for connection to a monitor / VCR, and features an easy-to-use "On-screen control". Kit contains: •1xReceiver / Switcher unit •1xWireless CCD camera •2xHigh-gain rubber-ducky aerials •2xAC/DC Plug-pack power adapter •1xRCA cable set and adapters for connection to monitor / VCR Cat. QC-3445

$599

LASER POINTER MADNESS

Not available in NSW!

PEN TYPE Cat. ST-3100

Only $20

KEYRING TYPE Cat. ST-3102

Only $15

HALOGEN LAMPS CRAZY PRICES

MR16 HALOGEN LAMPS Normally $5.50ea with a glass cover, these do not have the cover. Pay up to $8 in the lighting shop for these. Limited quantity available. Be quick. Three types available.

1) **Large 51mm 12V 20 Watt 38°** Cat. SL-2790
2) **Large 51mm 12V 50 Watt 38°** Cat. SL-2792
3) **Small 35mm 12V 20 Watt 38°** Cat. SL-2793

Only $2.75ea THAT'S HALF PRICE

DSC 5 Sector Alarm Deal

This system includes the DSC 5 sector alarm panel with Austel Approved dialler. Connect it to an alarm company or it can phone you or your neighbours etc.

INCLUDES: •1 x DSC 5 zone alarm / dialler •3 x Pulse PIRs •1 x mains 3 wire power supply •1 x 7.0Ah backup battery •2 x reed/magnet switches •1 x strobe •1 x metal siren cover •1 x siren horn •1 x internal siren •2 x deterrent stickers •100 m of 6 core alarm cable

Cat. LA-5460 **Was $659**

Now $529 Save $130

Low Cost 3.5 Digit, Digital Panel Meter Sellout

Common Features:
•200mV full scale input sensitivity •Single 9V DC operation
•Decimal point selectable •Auto polarity indication
•Guaranteed zero reading for OV input
•High input impedance > 100Mohm

LCD Panel Meter

Cat. QP-5550

Was $22.95ea

Now $14.95 Save $8

LED Panel Meter

Cat. QP-5560

Was $27.95ea

Now $16.95 Save $11

4 Door Car Power Door Lock Kit Sale!!!

Complete with 2 master solenoids and 2 remote solenoids. (Masters for the front doors, so opening either will unlock the other 3 doors). Suitable for connection to car alarms with negative triggering central door locking output. Most car alarms are negative triggering output. Full wiring harness to connect all 4 solenoids to the doors of even the biggest cars, all hardware. Also included is the controller relay circuit which also will adapt to our remote controller Cat. LR - 8820, so the system can be remote controlled. Beware of lower priced, inferior quality lock kits. Cat. LR-8830

DON'T MISS OUT

Was $59 May $49 Save $10

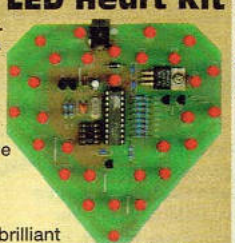
Ergonomic Supercrimp Tool

40% less handle force required. Cat. TH-1950 **$59.95**

Dies To Suit The Supercrimp Tool

•4P4C telephone handsets Cat. TH1951 $22.95
•6P6C telephone connectors Cat. TH1952 $22.95
•8P8C network connectors Cat. TH1953 $22.95
•Fully Insulated Crimp Terminals Cat. TH1954 $19.95
•BNC/TNC coax connectors Cat. TH1955 $19.95
•F- type CATV to suit RG59 / RG6 Cat. TH1956 $19.95

Flashing LED Heart Kit



Ref. S.C. May 99. An ideal Mothers day present, or gift for the sweetheart. This fun kit has 30 LEDs in the shape of a heart. The onboard microprocessor generates many brilliant patterns, which should make any heart flutter. Great as a present, decoration or shop display. The kit is simple to build and is powered from a 9VDC power pack (use MP-3003). Kit includes heart shaped PCB programmed microprocessor, 30 LEDs, plus all electronic components.

Cat. KC-5266 **$29.95**

D37 R/A PCB Mounting Socket

NEW '99

Cat. PS-0865 **$4.75**

N Type Chassis Mount Socket

NEW '99

Cat. PS-0676 **$5.50**

DIN 41612 64 Way (Rows A & B) R/A PCB Mount Plug

NEW '99

Cat. PP-1204 **$2.75**

PCB Mount Box Header Plus 40 Way Vertical

NEW '99

Cat. PP-1114 **$1.35**

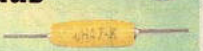
DIN 41612 64 Way (Rows A & B) Socket Vertical PCB Mount

NEW '99

Cat. PS-1206 **$2.75**

0.47µH RF Choke Axial Leads

NEW '99



Cat. LF-1508 **$0.95**

DIN 41612 96 Way (Rows A & B) Plug R/A PCB Mount

NEW '99

Cat. PP-1208 **$3.75**

Alps Brand Slider Potentiometer

NEW '99

10K log 50mm travel. Japanese quality. Cat. RP-3920 **$2.45ea**

BULK USERS - CONTACT OUR WHOLESALE DEPT FOR SPECIAL PRICING (02) 9743 5222

MAIL ORDER CORNER

Only available by ordering from our Mail Order Department direct.
NOT AVAILABLE AT OUR RETAIL OUTLETS
Call 1800 022 888 & have your credit card handy!

Seiko Instruments Intelligent Dot Matrix LCD Display

This is a 2 line x 20 character display with built in controller chip. Character heigth 3.2(W) x 4.85(H). 5 x 7 dot matrix configuration (alphanumeric). Supplied with full data. Overall dimensions 116(W) x 37(H) x 11(D). Cat. GG-1067 **Only $19.95**

Quantity Strictly Limited

Computer Printer Switch (Manual)

2 to 1 or 1 to 2. RS-232 (3 x D25 female ports) can be used (of course) for any RS-232 switching. All 25 conductors wired. Guaranteed 15,000 cycle life. Cat. GG-1068

$10 each

You will buy it to look at it!!

Magnificent US made 12 position x 4 gang wafer switch. This unit is hand made by the famous OAK company of the USA. It features heavy duty construction. eg. the switch contacts are mounted on wafer made out of fibreglass - like material which is about 3mm thick! Each detent is positively located with 2 x 4mm locating balls. Mounting is by way of 3/8" 32 THD bush & 1/4" shaft with 25% flat. It even weighs in at a substantial 160 grams. Ideal for audio switching applications. 50 dia. x 60 long (+ control shaft).

Cat. GG-1069 **Only $15 each. Limit 2 per person**

TURN YOUR SURPLUS STOCK INTO CASH!
Jaycar buys surplus/distress stock of most electronic products from components to built products. If you have marketable quantities of stock you need to clear contact Bruce Routley on Ph: 02 9743 5222 Fax: 02 9743 2066

New Computer Fans

NEW

For full details refer page 189, in our 1999 Cat.

Notebook Cooling Kit

This notebook cooler simply plugs into the PCMCIA slot to extend the life and reliability of your notebook. With a handy travelling pouch, it is ultra-quiet and has a washable filter. Specifications: •Dimensions: 156 x 58 x 18mm (Fan is 50 x 50 x 10mm) •Operaing Current: 0.09A •Operating Voltage: 5V •Power Comsumption: 0.45W •Fan Speed: 3500 rpm •Airflow: 8.0 CFM •Noise Level: 21 dBa

Cat. XC-5048 **$39.95**

Monitor Cooling Fan

Used to maintain cool air circulation in your computer monitor, this patented high-performance fan can drop the temperature of your monitor by more than 30 degrees Centigrade. Comes with 1.6m lead and power adaptor, and will fit any monitor. Heat is the main killer of monitors. Specifications: •Operating Voltage: 12V

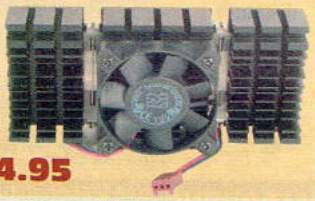
Cat. XC-5049 **$29.95**

Cooling Fan for 3.5" Drive Bay

Keep your valuable hard drive(s) cool and improve reliability with this high-performance exhaust fan. Features a two-in-one power connector - just plug into your existing hard drive connector if there isn't one spare. Heat lowers the efficiency and overall reliability of your HDD. Specs: •Operating Voltage: 12V

Cat. XC-5047 **$39.95**

CPU Cooler for Pentium II



High-performance Pentium II CPU cooler with a multi-finned, high-efficiency heatsink. It's lever-style mounting clips make it a snap to install / remove from your system, and the ball-bearing fan helps to give very low power consumption. Cat. XC-5050 **$24.95**

PCB Test Terminals

PCB mounted test points, perfect foil clipping on alligator clips or test probes. Discrete wires, set-on-test components which require frequent replacement can easily be mounted through the eyelet. The glass bead insulator is suitable for raising hot components off the circuit board. The phosphor bronze tinned spring terminal prevents damage to through plated holes and assures the terminal remains in place when soldering. •Loop diameter: 1.3 - 1.5mm •Pin length: 2.78mm •Bead diameter: 2.35mm •Bead height:3.3mm •Recommended PCB hole diameter: 1.0mm •Recommended PCB thickness: 1.59mm

Cat. HT-1265 **Pkt. 25 for $3.95**

You're Choking!

NEW

We thought this was a tranny at first. Further inspection revealed that it is in fact a heavy duty DC Choke. It would be rated to carry 15A DC easily. Our bridge measured them at 0.78mH or 78µH. This would make them pretty handy for ripple suppression in car audio. There is more to it than that though. They are really beautifully Swedish made. They have machine threaded end plates & can be dismantled easily. You could easily pull the thing apart & wind another value choke or even a transformer (taking care to remove the air gap spacer in the laminations. 60(W) x 50(H) x 45(D).

Cat. AA-3082 **Only $10 each**

2.8 Amp 24 to 13.8 Volt Reducer

WAS $43.95

Ideal for cellular phones. This reducer will drop 24v to 13.8 volts with continuous loads of 2.8 amps. It is fully protected & is ideal for truckies running a 12 volt cellular phone on the 24 volt truck power. Specifications: •Standard operating voltage: DC24 volts •Output over voltage protection •100(L)x 64(W)x 22(H)mm For full specs. see page 110 in our 1999 Cat.

Cat. MP-3058 **Save $10**
Was $39.95 Now $29.95

1.5 Amp Regulated* 12V to 1.5, 3, 4.5, 6, 7.5, 9 & 12V

12V TO 1.5/3/4.5/6/ 7.5/9/12V AT 1.5 AMP

The best car converter we have ever seen.

If you require more than 800mA to power a stereo etc, this unit will supply 1.5 amps.Supplied with 7 different plugs, includes a LED monitor, short circuit protection and replacable fuse for overload protection.
*Note - 12V output is not regulated.

Cat: MP-3019 **Save $9**
Was $33.95 Now $24.95

Kingcell Super Alkaline Batteries

0% Mercury & Cadmium

NEW

AA	Pkt of 2 Cat. SB-2424	**$2.50**
AA	Pkt of 4 Cat. SB-2425	**$4.50**
AAA	Pkt of 2 Cat. SB-2426	**$2.75**
C	Pkt of 2 Cat. SB-2416	**$4.20**
D	Pkt of 2 Cat. SB-2418	**$4.95**
9 V	Pkt of 1 Cat. SB-2423	**$4.95**

Why would you pay more for name brands.

Look at our Range of Remotes!

We now have a fantastic range of 5 Remote Controls to suit the children or elderly who want something basic & simple to operate, to the more sophisticated models for the budding enthusiasts.

SEE 99 CAT. PAGE 217 FOR FULL DETAILS

ALL NEW

Cat. AA-1702 **$24.95**
Cat. AA-1700 **$37.95**
Cat. AA-1704 **$44.95**
Cat. AA-1706 **$79.95**
Cat. AA-1708 **$129.95**

Pearl Catch

Incredibly handy tool for those moments when you need to pick up small fiddly bits and pieces. Will clip to and hold small nuts, bolts, washers, transistors, resistors, etc. Metal construction with handy pocket clip

Was $6.95 Save $2.95

May $4.00 Cat. TH-1842

Budget Computer Tool Kit

Includes •IC inserter •Blank hex driver •Reversable bits •T10/T15 driver bit •Philips 0 & 1/8" slot bit •Philips 1 & 3/16" slot bit •Nut drivers 3/16" & 1/4" •Spare parts tube •Pearl catch •Tweezers •IC extractor.

Was $14.95 Save $4.95

May $10 Cat. TD-2039

AURA INTERACTOR BODY BLASTERS CUSHION

FEEL THE ACTION

SAVE $200

MAY $49.95

We have made a huge distress stock purchase from AURA in USA. We have sold thousands of the Interactor Backpacks, and now can offer a CUSHION VERSION, for a crazy low price. The cushion should sell for well over $200, but you can grab one - or more, for only $49.95 each, while stock lasts. THEY ARE WELL UNDER 1/2 PRICE! This Interactor Cushion will transform low sounds into movement, so you can actually feel these through your back. Simply place in your lounge chair, or seat, and complete a 3D sound environment for added impact for home theatre, computer games etc. The Interactor Cushion can be used with almost any PC/Mac, home theatre system, CD player or video. Supplied with black cushion (with inbuilt shaker), amplifier module, 240V mains power supply and connecting lead set. **Cat. XC-1005**

BACKPACK

MAY $39.95

Cat. XC-1000

Plug it into computer games, stereos etc, then put the back pack on and feel all the low frequency sounds. See 98 Cat. page 213 for full details. SAVE $200

AURA ADAPTOR CABLE FOR N64 & PLAYSTATION

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NEW 99

This brand new display is designed basically for an oven timer. It can easily, however, be used as a custom clock display. Vacuum Fluorescent displays are very attractive and this one - in green - is as well. The 4 digits are 14.5mm high. Each segment of each digit is separately addressable as is the AM annunciator. Overall dimensions are 98W x 34H x 8Dmm (excluding pinouts, etc). A fairly poor (but readable) copy of the factory data is included.

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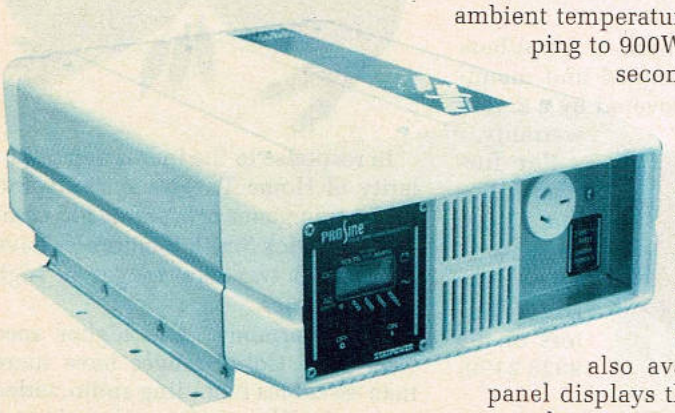
PRODUCT SHOWCASE

1800W/230V Inverter With Pure Sinewave Output



If you've ever needed to run sensitive test equipment, computers, audio or video equipment from an inverter, you would know the problems most inverters cause. That's because most inverters have at best a modified sinewave output, meaning harmonics, distortion and interference.

A new 1800W inverter available through Bainbridge Technologies solves that problem because it has true sinewave output, enabling devices connected to it to run at their full rating. Motors, for example, start easier and run cooler and quieter.

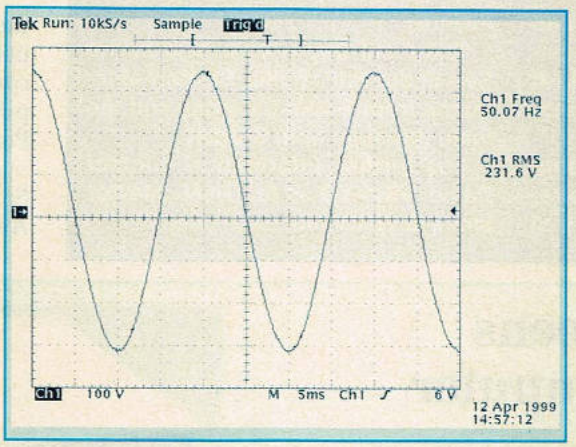
Measuring 391 x 279 x 115 (mm) and weighing 7.5kg, the Statpower Prosine 1800 is no lightweight – but then again, with 1800W output, you wouldn't expect it to be. It features short circuit protection, under/over voltage shutdown, over temperature shutdown, overload shutdown and AC backfeed protection.

Battery polarity is clearly marked but if you do manage to connect the battery with reverse polarity battery an internal fuse will blow and service will be required.

Total harmonic distortion (THD) is claimed to be typically 1% while efficiency is claimed to range from 84% at 200W out up to 90% at 1kW out, dropping marginally at full output. The output must be derated above ambient temperatures of 35°C (dropping to 900W at 60°C). The 5-second surge rating is 2900W.

Connection is via a pair of large bolt terminals and power output is via a standard 240V AC mains socket (a hard-wired version is also available). An LCD panel displays the DC input voltage and current while a bargraph shows the AC output in watts. The same panel will also display a range of fault conditions.

With a current drain of 170A or more at full output, a heavy duty battery is required. Statpower specify a range of deep cycle batteries such as those used in marine, recreational vehicle and golf cart applications. Standard automotive batteries are not recommended, except in emergencies.



In use

We must admit we had a problem when we fired up the Statpower Prosine 1800. Not so much with the inverter operation – that was fine. We have the 'scope pattern to prove it: you couldn't want a much better sinewave (ignore the digital scope artefacts on the waveform).

And look at those measurements: as close to 50Hz as possible and the voltage just a tad over spec at 231.6V. That was with a load of about 200W.

No, our problem was with our battery. Against the specific warning about using a car battery, we used. . . a car battery. None of us at SILICON CHIP is fortunate enough to own a golf cart or a fork lift so we couldn't purloin a big battery.

We tried to get away with a littlie: it tried hard but couldn't handle the load. When we tried to draw significantly more power, the inverter did exactly the right thing and shut down. The LCD display told us why – under voltage). We tried using some monstrous leads (400A-ish) but it was the battery that was letting us down.

Still, the results we did achieve lead us to believe that the Statpower Prosine 1800 would deliver the goods if used correctly.

Curiosity got the better of us and we had a good look inside – and were impressed! It's very well constructed and looks as though some very serious design work indeed has gone into this inverter! That's not surprising, because Statpower makes a large range of similar equipment.

Incidentally, if you're looking for a smaller inverter, Bainbridge Technologies have available a much smaller (and lower cost) 150W inverter intended for domestic appliances and small hand tools (see pic below).

For further information contact Bainbridge Technologies, 77 Shore St, Cleveland, Qld. Tel (07) 3821 3333. Fax (07) 3821 3977.

Redback PA Amps from Altronics

Altronics has released a new range of Redback Phase 4 Public Address Amplifiers. Available in either mixer or booster format the Phase 4 incorporates thermally cued on demand cooling coupled with a custom-designed heatsink tunnel ensuring the amplifier runs cool under all conditions.

Power outputs of 125 + 250W for the mixer amps and 125, 250 and 500W for the booster amps ALL in a 2RU chassis.

The output is AGC limited to prevent dangerously high voltages appearing at the output when lightly loaded.

Distortion is typically less than 0.2% at 1kHz full power full load, while LED monitors show output level, input presence, overload, AGC and power.

The Redback Phase 4 Amplifiers are Australian designed and manufactured and are covered by a 2 year warranty.

For further information contact Altronic Distributors on 08 9328 2199.

Oxley Amateur Field Day

One of the premier events for amateur radio operators and electronics enthusiasts of the mid-north and north coasts of NSW, the Oxley Amateur Field Day, is again being held at Port Macquarie on the Queen's Birthday weekend, June 12&13.

This annual event is very popular with exhibits and demonstrations from a number of suppliers of equipment, the usual "bring and buy" flea market and various fox hunt events.

The Field Day will be held at the Sea Scout Hall, Buller St, Port Macquarie from 1-4pm Saturday and the main day, 9am-4pm Sunday

For further information contact David, VK2AYD on (02) 6585 2647 or email davpil@midcoast .com.au

High Quality A/V Cable Range From DSE

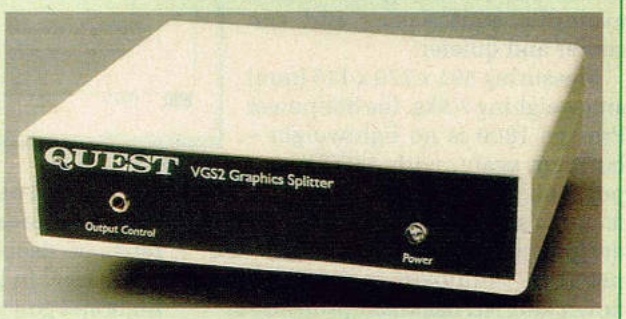
In response to the increasing popularity of Home Theatre systems and the re-emergence of separate hifi components, Dick Smith Electronics have introduced two new ranges of high quality cables.

The "Harmony" and higher spec "Harmony Gold" ranges have more than 40 cables including audio, video and optical, in a variety of lengths and connectors. They range in price from $12.95 for the Harmony 2-metre RCA/RCA lead up to $49.95 for the 5-metre Harmony Gold 3xRCA/3xRCA lead.

The optical cables are suitable for the latest technology consumer products such as DVD players, digital video cameras, mini disc players and amplifiers with Dolby Digital and Dolby ProLogic.

All cables are available from Dick Smith Electronics stores throughout Australia or via mail order.

Two VGA Screens From One Computer



There are many applications where computer images need to be displayed to a wider audience than one monitor will allow.

Education is the most obvious but demonstrations, retailing, computer presentations, point-of-sale and even computer video/games/entertainment can all benefit from a second screen.

Questronix have released a small VGA splitter, the VGS2, which does exactly that: 1 VGA input in, 2 out. Perhaps even more importantly, the second screen can be up to 65 metres away from the source using "HQ" cables.

The system works with VGA, SVGA and XGA signals. It also has the ability, via an optional remote switch assembly, to send the remote screen black while the local screen remains active.

This is very handy in education where a teacher or trainer wants the students' attention. Or it can be used to load programs or sensitive information without that being viewed on the remote screen.

Priced at $169 (inc tax) and including a 12V plugpack supply and one VGA computer lead, the VGS2 is available direct from Questronix, PO Box 548, Hornsby NSW 2076. Tel (02) 9477 3681, Fax (02) 9477 3569.

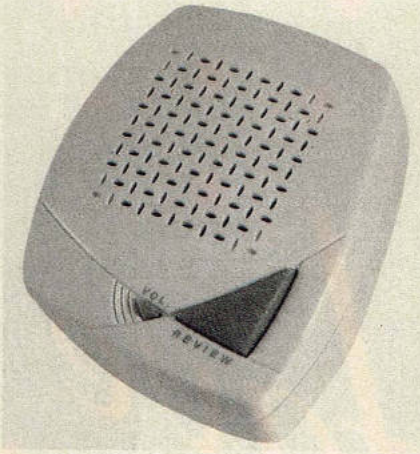
More information is also available from their website, www.questronix. com.au/~questav

You've Heard of Caller ID; Now There's Talking Caller ID!

Jackson Industries, one of the major suppliers of telephone and communication accessories to retailers in Australia, has introduced a Talking Caller ID unit to the Australian market.

The Model TC509 ID unit connects to the telephone line in the same way as conventional caller ID units but instead of displaying the calling number, announces it after the first "ring". This patented technology, developed in the US, will be available in Australia from June this year. Recommended retail price is $59.95.

The unit stores the last 10 calls for review and will announce the number, time and date of each incoming call for later review. In future months other models will be released which feature both incoming caller ID announcement and number display.



For further information, contact Jackson Industries, PO Box 6388 BHBC, Baulkham Hills, NSW 2153. Phone (02) 9899 8833; Fax (02) 9899 8378; email chris@ji.com.au.

Intusoft Offers Free Books

Intusoft has announced that they are giving away free copies of their popular Power Specialist's App Note Book on their company website. In addition, Intusoft has initiated a "SPICE Model of the Month" posting on their website.

The book, an information-packed handbook for power supply designers, contains over 35 technical articles on power supply design and power electronics modeling.

The book is available for immediate down-load from the Intusoft website, both in its entirety (in pdf format), or in individual articles at: http://www.intusoft.com/psbook.htm.

The individual articles are also available in the Adobe Acrobat "pdf" format.

Intusoft's web site also features a new posting of a "SPICE Model Library of the Month". Each month, a new SPICE model library will be available free.

The "SPICE Model of the Month" can be found at: http://www.intusoft.com/models.htm.

The company offers other free SPICE models at: http://www.intusoft.com/models.htm#freemodels .

Nepcon '99 for Melbourne

The electronics equipment and component show, Nepcon 99, will be held in Melbourne's Exhibition and Convention Centre from 25-27 May.

The Australian debut of Nepcon in Sydney was hailed by exhibitors and visitors alike as a benchmark for the electronics industry's direction into the next millennium.

This year, Nepcon will feature the latest local and international electronics products including: design and manufacturing equipment, PCB fabrication and assembly components, test and measurement equipment, EMI/RFI products, satellite and microwave technology, defence equipment, electronic design tools, racks, enclosures and components.

Another first at Nepcon '99 will be an informative specialised conference featuring national and international guest speakers who will present tutorials and workshops.

The focus and theme of the conference is 'Education' and a comprehensive speaker and workshop program has been organised.

For further information on Nepcon '99 contact Reed Exhibitions Companies on (02) 9422 2518. SC

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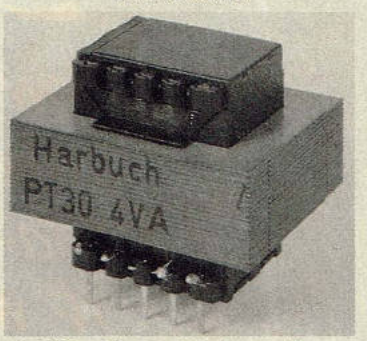

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RED SHIELD'99

Tell someone you love them!

Have a Heart

Now is the month of May-ing.
when merry lads are play-ing.
Fa-la-la-la and as everyone knows,
it will soon be Mother's Day.

So we have produced a project for Mother's Day and for any other day that you want to tell someone you love 'em. It is the Heart of LEDs. Build it now and you'll be in that special someone's "good books".

by LES GRANT*

BACK IN NOVEMBER 1998 we published the "Christmas Star". It turned out to be very popular and just the ornament for the top of the Christmas tree.

We're taking the same basic idea and indeed the same circuit to produce a version for Mother's Day: the Heart of LEDs.

Now you can have something different to give to that special Mum or Grandmother. Or you may be able to redeem yourself if you forgot St Valentines Day!

Either way, the Heart of LEDs will certainly last a lot longer than the traditional bunch of flowers!

Or, if you don't want to give your heart away, you can actually wear it "on your sleeve" or better still, on your lapel.

This is readily done if the Heart of LEDs is powered from four AA cells and these could be installed in a 4-cell holder which you keep in your pocket.

The Heart of LEDs is a modestly sized PC board with an array of 30 LEDs arranged in two concentric heart-shaped patterns, ie, one heart inside the other. Driven by a single IC microcontroller, it flashes the LEDs in a seemingly endless sequence of patterns.

For those who don't like microcontroller projects, just pretend the micro is a dedicated LED driver IC that happens to have been designed to control 30 LEDs in the shape of a Heart (what a stroke of luck!).

And it won't be declared obsolete just after publication like a purpose-designed IC might be!

As the design is derived from the Christmas Star, those readers who saw that article will notice that the schematic is very similar.

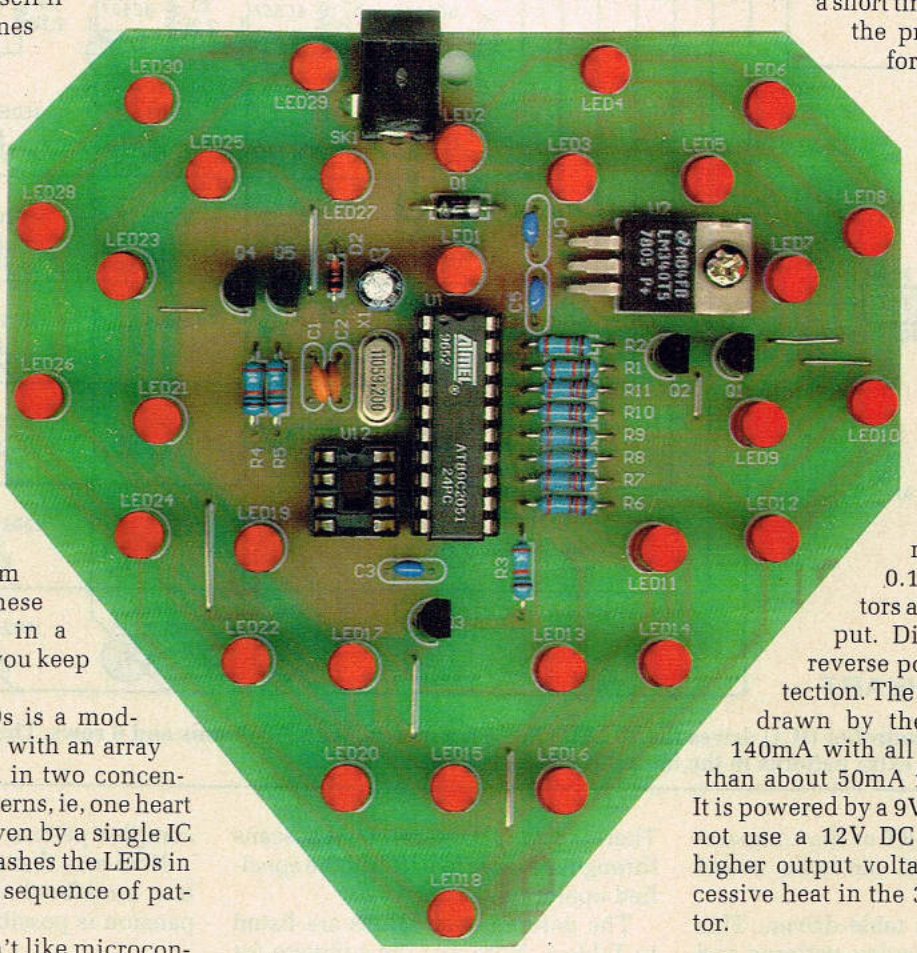
In fact, you might think it is identical but the row connections to the microcontroller are different.

The major differences between the Heart and the Star are in the shape of the PC board, the physical layout of the LEDs and the software.

Why use a Microcontroller?

Using a PC parallel port to control external devices is a popular approach these days but imagine the response when you present your Mum with a flashing Heart attached to an umbilical cable running into the next room!

No, self-contained is better.



Heart of my heart: give this to your Mum on Mother's Day or wear it on your lapel when you're out and about. This board has the 8-pin socket for an optional EEPROM but this can be left out.

The answer is to use a small microcontroller. They are cheap and easy to use. And if the software doesn't work first time (when does it?), you simply change the program and re-program the micro.

As this project demonstrates, by changing the software you can make a circuit which originally did one job do something quite different.

Now we're not going to go into the ins and outs of the circuit because that was done in the November 1998 issue of SILICON CHIP. We'll just mention that the microcontroller is the Atmel AT89C2051 and is a version of the 8051 family.

Here it is used to drive 30 LEDs which are connected in an X-Y matrix; ie, the LEDs are interconnected in 6 rows and 5 columns.

The appropriate combination of LEDs in a column is switched on for a short time (about 2ms) and the process is repeated for each column, taking just 10ms for a full cycle. Provided the multiplexing is done quickly enough, the persistence of vision "fills in the gaps" and we see all combinations of LEDs without any flicker.

The power supply uses a 7805 3-terminal regulator with 0.1µF bypass capacitors at its input and output. Diode D1 provides reverse polarity power protection. The maximum current drawn by the Heart is about 140mA with all LEDs on but less than about 50mA for most patterns. It is powered by a 9V DC plugpack. Do not use a 12V DC plugpack as the higher output voltage will cause excessive heat in the 3-terminal regulator.

The software

As with the Christmas Star, the basic source code for the Heart will be available free (you can download it from www.grantronics.com.au). An extended version that uses an optional 24C16 EEPROM for storage may also eventually become available.

The software is written in C language using the low cost Dunfield Development Systems Micro/C compiler. There is nothing particularly smart or tricky about the software – it was written to be easy to understand and to encourage use of small micros.

Consequently, there are no interrupt routines and no use of the coun-

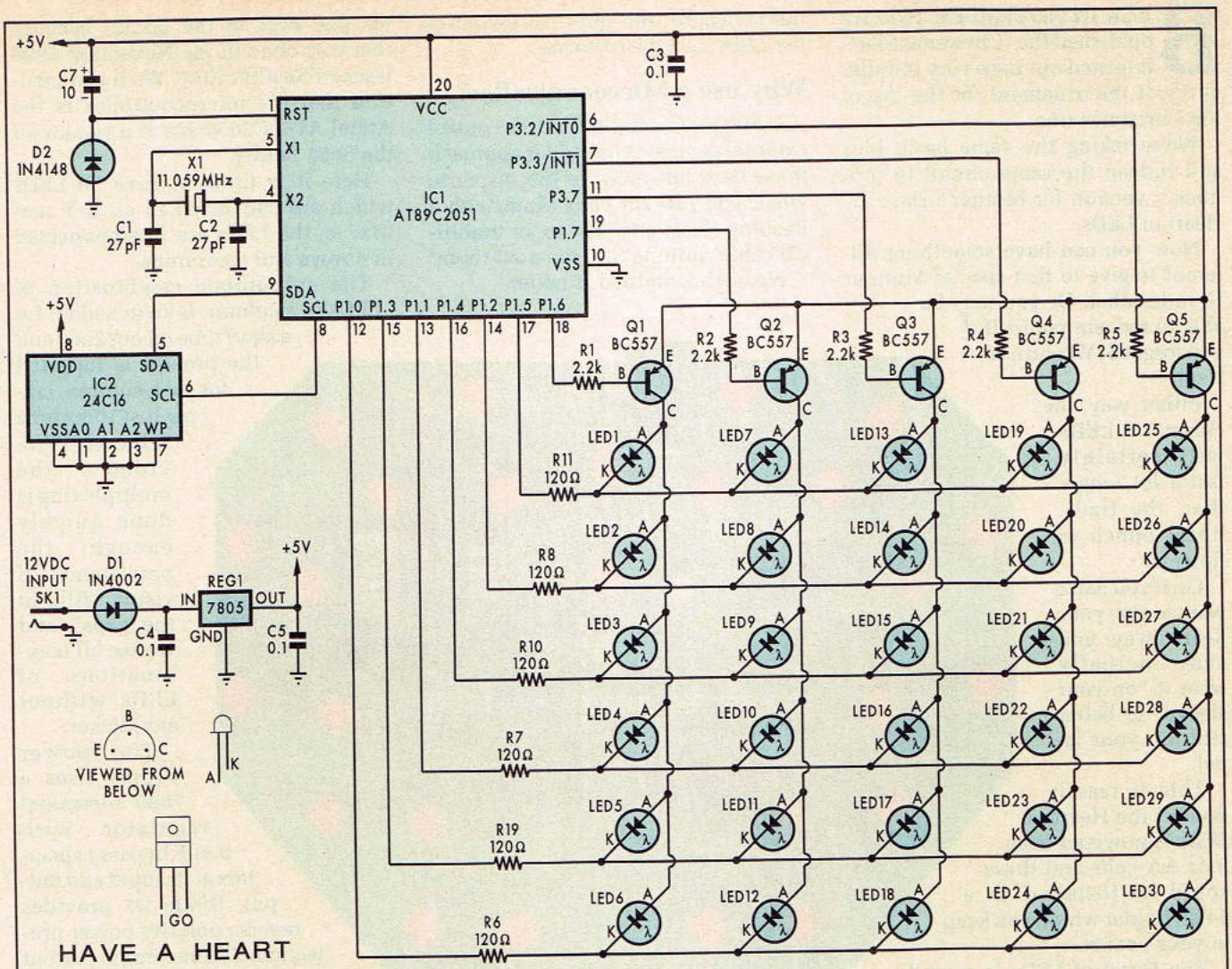


Fig.1: the microcontroller (IC1) drives the 30 LEDs in a 5 x 6 matrix, with 5 columns and 6 rows. The EEPROM is optional, to store extra patterns in the future. It can be left out.

ter/timers, the UART or the comparator though Micro/C can make use of these resources.

The software is table driven. This means that the display patterns and sequences are determined by data stored in a table (an array of bytes). There is a simple interpreter that scans through the table to perform the specified operations.

The defined byte values are listed in Table 1. Note that the software for the Heart is a little smarter than for the Christmas Star – so it can do more complex pattern sequences.

Note also that there are still quite a few undefined values so future expansion is possible.

Table 1: Software Table

Byte value or range	Operation
01 to 30 (0x01 to 0x1e)	Turn on LED 1 to 30
33 to 62 (0x21 to 0x3e)	Turn off LED 1 to 30 (LED number = byte - 32)
64 (0x40)	Go back to byte after loop start
65 to 79 (0x41 to 0x4f)	Loop start, count = byte - 64
128 (0x80)	Delay (use last delay count), each count = 10ms
129 to 191 (0x81 to 0xbf)	Delay, count = byte - 128, each count = 10ms
253 (0xfd)	All LEDs on
254 (0xfe)	All LEDs off
255 (0xff)	End of table

Putting it together

Assembly of the PC board is quite straightforward. You will need a soldering iron with a fine tip, preferably temperature-controlled to about 320°C.

The first step is to carefully check for shorts between tracks and broken tracks. Fit the smallest parts first, the wire links, followed by the resistors and diodes.

Next, fit the crystal (or resonator) and the IC socket for the micro. Then install the transistors, capacitors and LEDs.

Pay particular attention to the orientation of the LEDs – they all point

the same way but they don't work when installed backwards!

Finally, install the 3-terminal regulator and the 2.1mm DC power socket. Don't insert the micro into its socket just yet.

Do another close visual inspection, looking for solder bridges especially on the transistor pads. Then apply power and check for the presence of 5V between pin 20 (+) and pin 10 of the socket for IC1.

If all is OK, remove the power, plug in the micro (make sure it's the right way around) and apply power again.

The micro then generates quite a range of patterns with the LEDs which then repeat after a while.

Running it from batteries

Earlier, we mentioned the possibility of running the circuit directly from four AA cells; ie, 6V. To do this, you would need to omit the 7805 regulator and connect a link from D1 to C5.

This will give a supply rail of close to +5.4V. Note that the diode must be present because the maximum supply for the microcontroller is 6V.

The hole near LED2 may be used to hang the Heart. If you hard-wire the power supply, you may be able to use this hole as a strain relief and hang the Heart on the power wires.

Finally, the appearance of the Heart may be enhanced by placing a piece of red cellophane over the front.

Fault finding

If the 5V DC is not present, check the applied power polarity. The centre pin of the 2.1mm DC socket (SK1) must be positive.

Check that D1 is correctly fitted, and check the tracks from SK1 via diode D1 and the 7805 to IC1 for breaks or shorts. If one LED does not work, it may be inserted backwards or it may be shorted by a solder bridge between its pads.

If one group of adjacent LEDs does not work, check the circuitry and soldering around the appropriate column drive transistor.

If several individual LEDs do not work, check the corresponding row drive circuitry. Remember, faulty components are rare but soldering faults are common.

The future

The Heart is still evolving. That is part of the attraction of using a micro – it is so easy to change the behaviour by changing the software. And what about the optional 24C16 EEPROM? Well, an enhanced version of the Heart would read its data from the EEPROM for much longer sequences.

To check out the latest version of the software, log in at http://www.grantronics.com.au. If you don't have Internet access, send a stamped ($1) self-addressed envelope with an IBM format 3.5-inch disc to Grantronics and you will be sent the current software files.

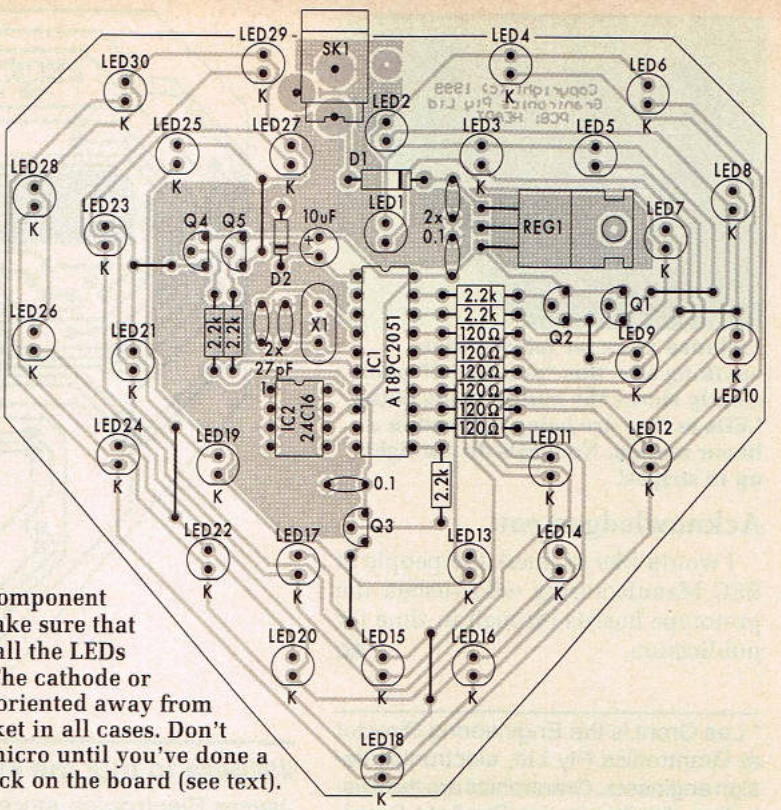


Fig.2: the component overlay. Make sure that you insert all the LEDs correctly. The cathode or flat side is oriented away from the DC socket in all cases. Don't insert the micro until you've done a voltage check on the board (see text).

Parts List

1 Heart-shaped PC board, code 08205991
1 2.1mm DC connector (SK1)
1 crystal or ceramic resonator, approx 12MHz (X1)
1 20-pin IC socket
1 9V DC 150mA plugpack or
4 AA cells and
1 4 AA cell holder

Semiconductors

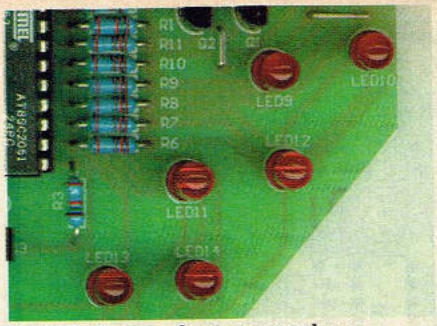
1 AT89C2051 programmed microprocessor (IC1) # – See next page
1 7805 5V regulator (REG1)
30 red LEDs (LED1-LED30)
5 BC557 PNP transistors (Q1-Q5)
1 1N4002 power diode (D1)
1 1N4148, 1N914 silicon diode (D2)

Resistors

5 2.2kΩ (code: red red red brown or red red black brown brown)
6 120Ω (code: brown red brown brown or brown red brown black brown)

Capacitors

1 10µF 16VW electrolytic
3 0.1µF monolithic or MKT polyester (code: 104 or 100n)
2 27pF ceramic (code: 27 or 27p)



Included more for interest than anything else, this "accidental" photo clearly shows the multiplexing of the LEDs as they are being scanned in a linear motion. No, LEDs do not light up in stripes!

Acknowledgement:

I would like to thank the people at BEC Manufacturing who rushed the prototype boards through in time for publication. **SC**

* Les Grant is the Engineering Director at Grantronics Pty Ltd, electronics design engineers. Grantronics are the Australian distributors for Dunfield Development Systems low priced software development tools. See the advertisement in the Market Centre.

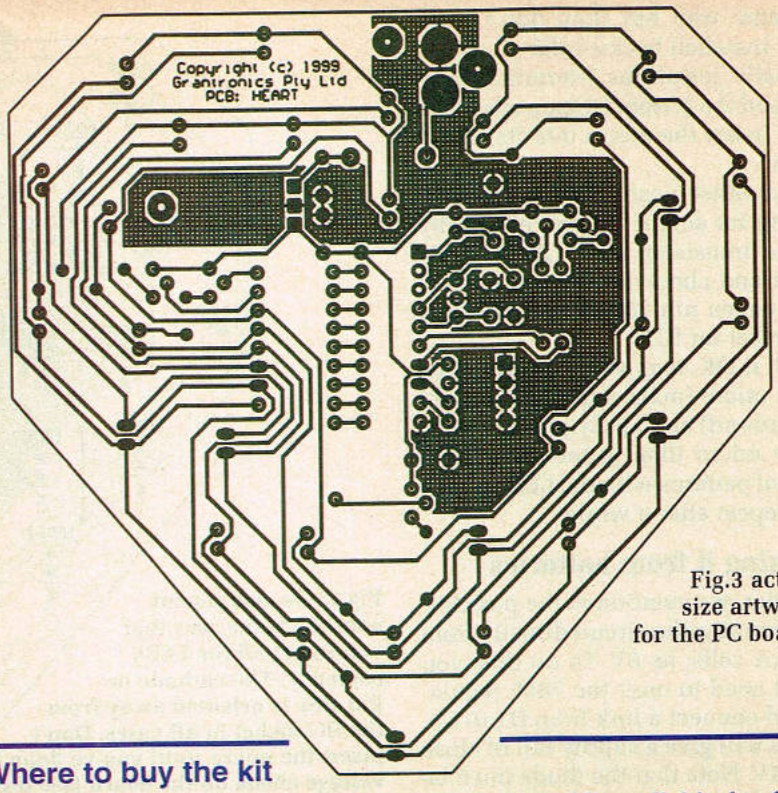


Fig.3 actual size artwork for the PC board.

#Where to buy the kit

Jaycar Electronics stores will have the complete kit available for $29.95. Alternatively, Grantronics Pty Ltd can supply the programmed microprocessors for $10 plus $5 for packing and postage. Send remittances to Grantronics Pty Ltd, PO Box 275, Wentworthville, NSW 2145. Phone (02) 9896 7150.

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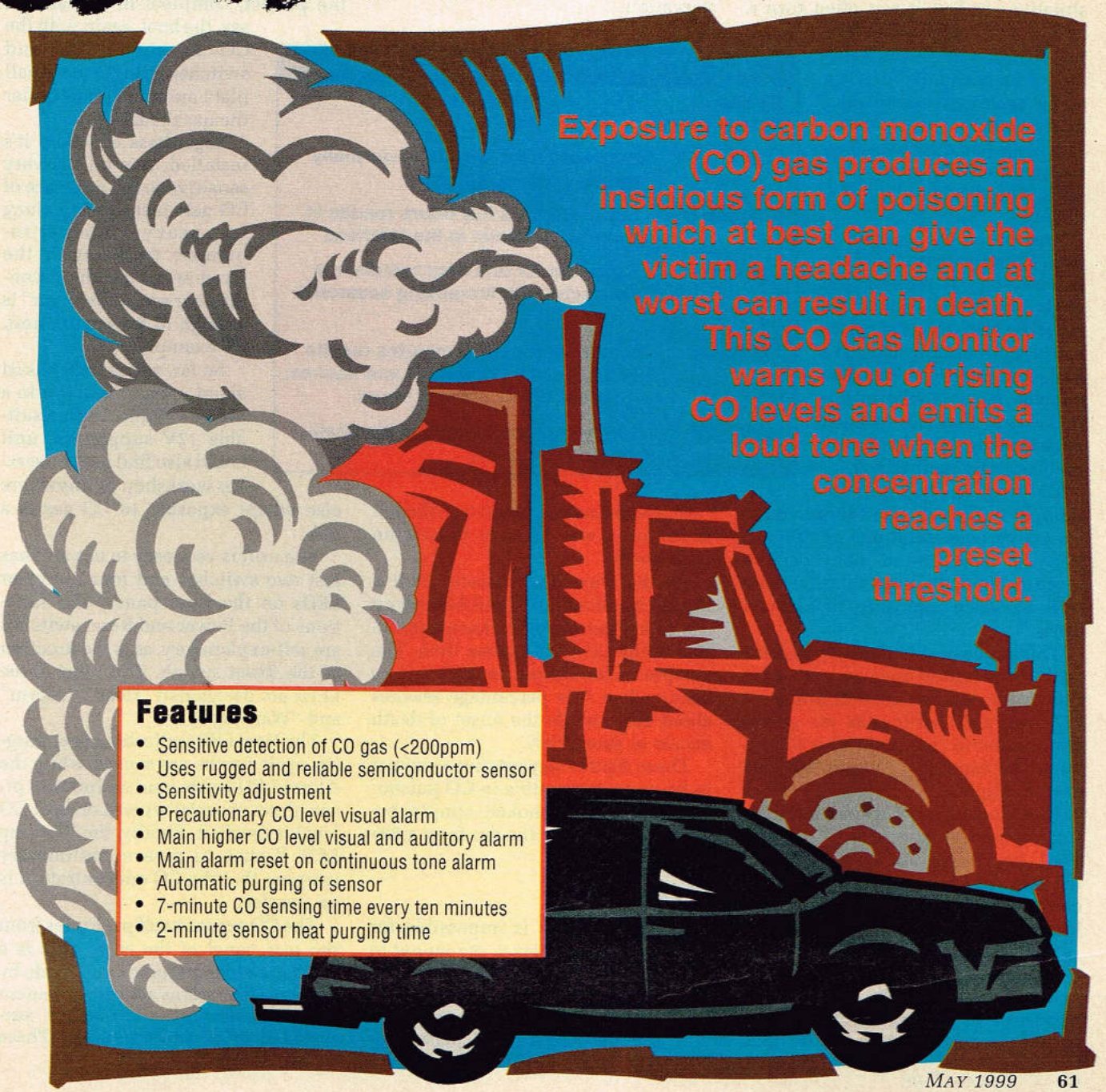
CARBON MONOXIDE ALARM

By JOHN CLARKE



Exposure to carbon monoxide (CO) gas produces an insidious form of poisoning which at best can give the victim a headache and at worst can result in death. This CO Gas Monitor warns you of rising CO levels and emits a loud tone when the concentration reaches a preset threshold.

Features

- Sensitive detection of CO gas (<200ppm)
- Uses rugged and reliable semiconductor sensor
- Sensitivity adjustment
- Precautionary CO level visual alarm
- Main higher CO level visual and auditory alarm
- Main alarm reset on continuous tone alarm
- Automatic purging of sensor
- 7-minute CO sensing time every ten minutes
- 2-minute sensor heat purging time

DON'T BE TOO COMPLACENT about the risks of CO poisoning in your car, particularly if you drive an old "bomb". Admittedly, there's not much risk in a modern car or if the vehicle is well maintained.

On older cars, however, there's a very real danger if the seal around the rear door or bootlid has deteriorated sufficiently to allow exhaust gases to seep into the cabin.

If the bootlid or rear door no longer seal properly, exhaust gases can be sucked into the rear of the vehicle as you drive along. Rust holes are another problem.

Opening a window doesn't ease the situation; in fact it can often turn a bad situation deadly by altering airflow within the vehicle. You could be driving along seemingly unaffected while your rear seat passengers cop a bad dose of carbon monoxide (CO) poisoning with possible fatal consequences.

The other big danger is from a poorly maintained exhaust system. If there's a hole anywhere in the system, it's possible that exhaust gases could seep past any defective seals and into the cabin. The answer here is obvious – make sure that the exhaust system is regularly inspected and correctly maintained.

Driving in bumper-to-bumper traffic can also expose you to excessive concentrations of CO gas. Because there are so many cars so close together, it's inevitable that there will be some exposure to exhaust gases.

This applies particularly if you drive with the window open or with your interior air fan or airconditioning set to "fresh air". Setting the fan or airconditioner to "recirculate" is the answer here, especially if you are stopped at traffic lights.

How do you know when you're being exposed to excessive CO levels? Well, you might not know until it's too late. That's because CO is utterly colourless and odorless but nonetheless quite deadly.

First symptoms, from quite small concentrations of CO gas, are headaches, nausea and dizziness, while exposure to higher levels quickly causes unconsciousness and death.

An interesting point to consider here is that people often associate dizziness and nausea with "car sickness" or "motion sickness". However, it's quite possible that what is described as "car sickness" is really a good dose of carbon monoxide.

Table 1 shows the effects of various levels of CO concentration. As you can see, even small concentrations spell real danger. That's because carbon monoxide has over 200 times more affinity with the haemoglobin in your blood than oxygen. It literally stops the blood supply from carrying oxygen and if enough haemoglobin is affected, the brain suffers from oxygen starvation.

Table 1: Effects of CO Gas Poisoning and Symptoms

CO Gas Concentration	Symptoms
50ppm	Exposure for a few hours normally results in no symptoms
100ppm	Exposure for a few hours results in a slight headache in the forehead
500ppm	Exposure for one hour results in a headache with increasing severerity over time
1000ppm	Exposure for 20-30 minutes results in a headache, dizziness and nausea; possible death within 2 hours
4000ppm	Exposure results in possible death within 30 minutes

In severe cases, a blood transfusion is the only way to save the victim from death.

By the way, it's estimated that a heavy cigarette smoker will have about 5% of his/her available haemoglobin tied up by CO at any given time. The symptoms for CO poisoning begin to occur when this percentage reaches about 10%, while the onset of death occurs at about 20%.

These figures suggest that a smoker is far more susceptible to CO poisoning than a non-smoker, simply because they are starting out from a 5% higher base.

CO monitor

Because CO gas is impossible for the individual to detect, we set out to design an effective yet easy-to-build CO monitor. The end result is the self-contained unit described here.

It is housed in a small plastic instrument case which can be placed on the dashboard of your vehicle or mounted towards the rear of a van or station-wagon.

While presented as a standalone unit and perfectly practical as described, even this small case might look out of place in a today's modern cars – that's if you can find a suitable mounting position at all.

A more practical arrangement might be to mount the PC board without the case under the dashboard, with the CO sensor, front panel LEDs and switches mounted somewhere more suitable.

Another idea would be to mount the project, complete in its case in, say, the boot, again with the CO sensor, LEDs and switches brought to a small plate mounted on or under the dashboard.

Regardless of where it's installed, this unit is very sensitive to the presence of CO gas. Just driving along in heavy bumper-to-bumper traffic with the window open or the airconditioner set to "fresh-air" is enough to trigger the unit, for example.

So far, we've only talked about using this alarm in a motor vehicle. With a suitable 12V supply, the unit could also find use in a service workshop or anywhere else where exposure to CO gas is a risk.

The unit is very easy to use and has just two switches and four indicator LEDs on the front panel. The functions of the Power and Reset switches are self-explanatory, as is the function of the Reset switch. The other three LEDs are designated "Heat", "Alarm" and "Warning".

The Heat LED indicates a heat purging cycle for the gas sensor, while the Alarm LED lights (and an internal piezo alarm sounds) when a critical CO level is reached. Finally, the Warning LED flashes to give a preliminary warning that the CO concentration is on the rise.

The CO sensor itself protrudes from the rear panel of the case. This is a low-cost semiconductor unit made by Nemoto. It contains a heating element and a semiconductor sensor surrounded by a catalytic layer. These

Self-contained in a plastic case and plugging into a car cigarette lighter socket, the CO Alarm can be moved from vehicle to vehicle. Alternatively, it could be "built in", with or without the case.

parts are contained in a 19mm diameter cylindrical case with six pins protruding from the base and with a double gauze wire mesh over the element.

The double layer of wire mesh is there to prevent an explosion if the sensor is exposed to dangerous concentrations of inflammable gas.

In operation, the sensor is heated to a temperature of 130-170°C and when CO gas becomes trapped on the catalytic layer, electrons are transferred to the semiconductor element. This markedly reduces the effective resistance of the semiconductor element to reveal the presence of the gas.

When the gas dissipates, the resistance of the semiconductor layer returns to normal. Over time, other gases such as hydrogen, petrol vapours and alcohol vapours are absorbed onto the catalytic surface and cause contamination.

To prevent false readings, these are periodically burnt off by raising the temperature of the heating element to around 450°C.

By the way, in case you're wondering, this unit is really only suitable for detecting carbon monoxide. It is fairly insensitive to hydrocarbon vapours (although it can detect very high concentrations), which means that it is unsuitable for detecting petrol fumes.

Block diagram

Fig.1 shows the block diagram of the CO Alarm. The circuit is powered from a 12V supply (eg, via the cigarette lighter socket) and this is regulated to give a +5.5V rail using REG1. This rail then supplies the heater and the semiconductor element in the CO sensor, along with the rest of the circuit.

The sensor heater element must be driven correctly to successfully purge any contaminating gases on the semiconductor element.

The specifications state that the CO sensor be heated to 450°C for 1-3 minutes, while the CO sensing time should be 6-10 minutes. These times are set by the Timer circuit, with LED2 switching on during the heat purging period.

In this case, the Timer circuit heats the sensor element for two minutes when power is first applied and repeats this 2-minute heating (purge)

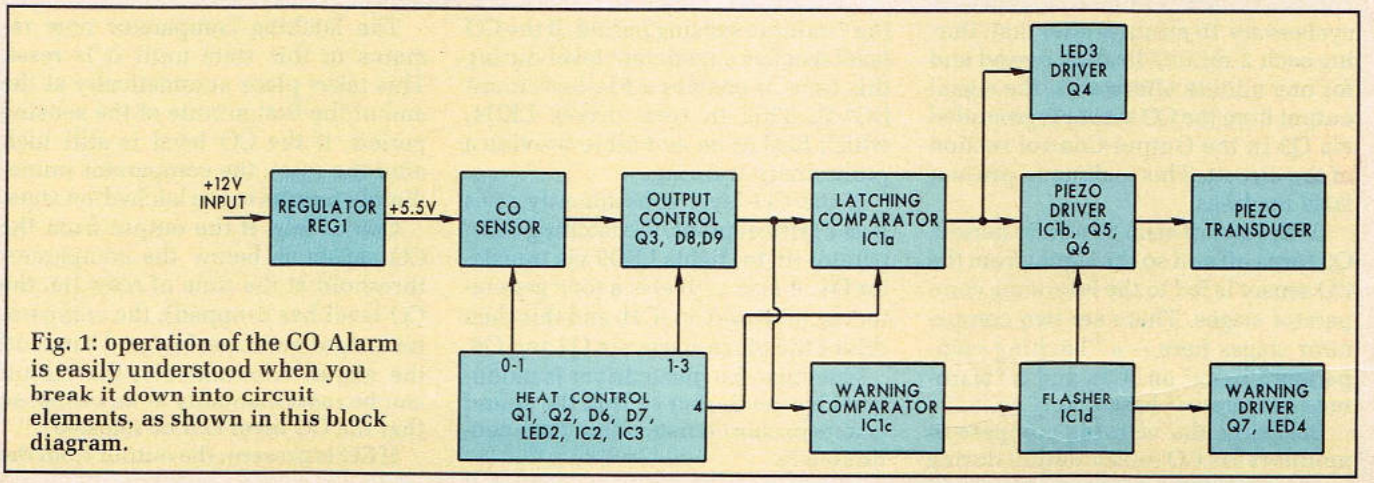


Fig. 1: operation of the CO Alarm is easily understood when you break it down into circuit elements, as shown in this block diagram.

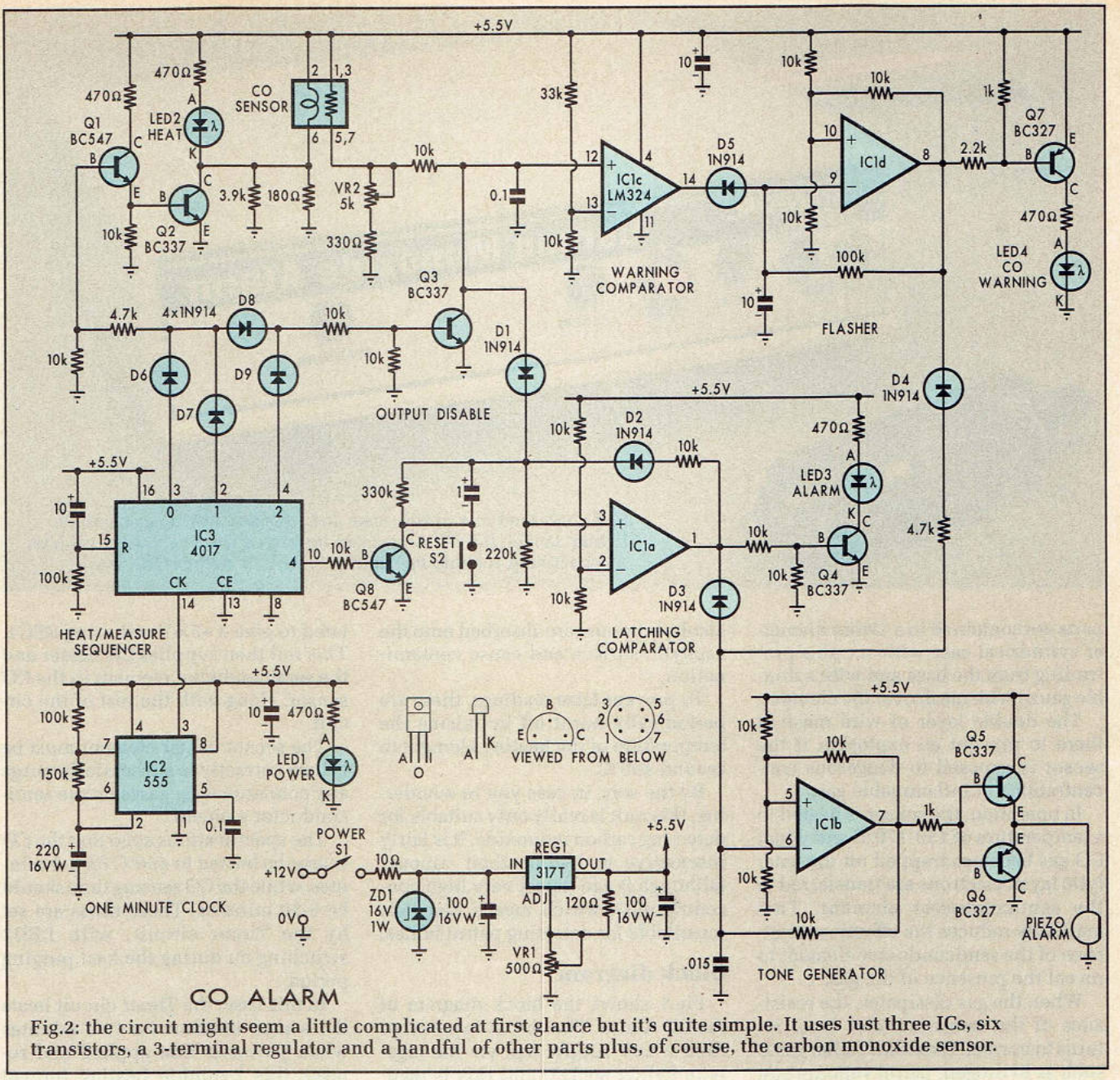


Fig.2: the circuit might seem a little complicated at first glance but it's quite simple. It uses just three ICs, six transistors, a 3-terminal regulator and a handful of other parts plus, of course, the carbon monoxide sensor.

cycle every 10 minutes after that. During each 2-minute heating period and for one minute afterwards, the signal output from the CO sensor is grounded via Q3 in the Output Control section of the circuit. This is done to prevent false readings.

At the end of each 3-minute period, Q3 turns off and so the signal from the CO sensor is fed to the following comparator stages. There are two comparator stages here – a "latching comparator" based on IC1a and a "warning comparator" based on IC1c.

Basically, the warning comparator monitors the CO sensor output during the 7-minute sensing period. If the CO level reaches a moderate level during this time, it enables a Flasher circuit (IC1d). This in turn drives LED4, which flashes on and off to provide a preliminary warning.

If the CO level subsequently rises past a critical point, the latching comparator (IC1a) lights LED3 via transistor Q4. It also activates a tone generator circuit based on IC1b and this then drives the piezo alarm via Q5 and Q6.

Note that the piezo driver is modulated by the flasher so that the sound occurs in short bursts rather than continuously.

The latching comparator now remains in this state until it is reset. This takes place automatically at the end of the first minute of the sensing period. If the CO level is still high after the reset, the comparator immediately returns to the latched-on state.

Conversely, if the output from the CO sensor is below the comparator threshold at the time of reset (ie, the CO level has dropped), the comparator output switches low and turns off the alarm. Alternatively, the circuit can be reset manually at any time, so that the CO level can be retested.

If CO is present, the output from the

CO sensor will normally only go low when heat purging starts again at the end of the 10-minute cycle. Provided it had already been triggered during the latter part of the sensing period, the piezo alarm will continue to sound into the purging period but the tone will change from pulsed to continuous.

This continuous tone indicates that the manual reset can be used to silence the alarm.

The circuit

OK, so much for the basic theory of operation. To find out how it all works in practice, take a look now at the full circuit diagram (Fig.2). It might seem a little complicated at first glance but it's really quite simple. It uses just three ICs, six transistors, a 3-terminal regulator and a handful of other parts – plus, of course, the CO sensor.

The +12V rail from the car's battery comes in via switch S1 and is applied directly to the input of REG1, an LM317T adjustable regulator. Zener diode ZD1 protects the regulator from voltage transients, while the 100µF capacitor provides supply decoupling.

In operation, REG1 produces 1.25V between the adjust (ADJ) and output (OUT) terminals. The 120Ω resistor between these terminals sets the current between them to 10.4mA and this current flows to ground through trimpot VR1. Setting VR1 to 408Ω gives 4.25V between ADJ and ground, which means that the output of REG1 will be at 4.25 + 1.25V = 5.5V. In practice, VR1 is simply adjusted for the correct output voltage .

A second 100µF capacitor decouples the regulator output, while LED1 provides power indication. The 470Ω resistor in series with LED1 limits the current through it to about 7mA.

IC2, a 555 timer wired in astable mode, forms the heart of the clock circuit. Its timing components are connected to pins 2 & 6 and consist of a 220µF capacitor and the 150kΩ and 100kΩ resistors. It operates as follows: initially, when power is first applied, its output at pin 3 is high and the 220µF capacitor charges towards the positive supply rail (Vcc) via the 100kΩ and 150kΩ resistors. When the voltage at pin 6 subsequently reaches $^2/_3$Vcc, pin 7 switches low, as does pin 3, and the capacitor discharges via the 150kΩ resistor until it reaches $^1/_3$Vcc. At this point, pin 7 goes open circuit again, pin 3 goes high and the capacitor charges once more to $^2/_3$Vcc. This cycle repeats indefinitely while ever power is applied.

The charging period for the 220µF capacitor is simply 0.693 x (100kΩ + 150kΩ) x 220µF, while the discharge period is 0.693 x 150kΩ x 220µF. This gives figures of 38.12s and 22.87s respectively, for a total period of just over one minute (60.99s).

In turn, pin 3 of IC2 clocks IC3, a 4017 decade (divide-by-10) counter. This counter has 10 independent outputs which sequentially go high on receipt of a clock signal from IC1.

When power is first applied, IC3 is reset via the 10µF capacitor on pin 15 (this capacitor briefly pulls pin 15 high) and so its "0" output at pin 3 is high. As a result, transistor Q1 is turned on via D6 and the associated 4.7kΩ base resistor. Q1, in turn, drives

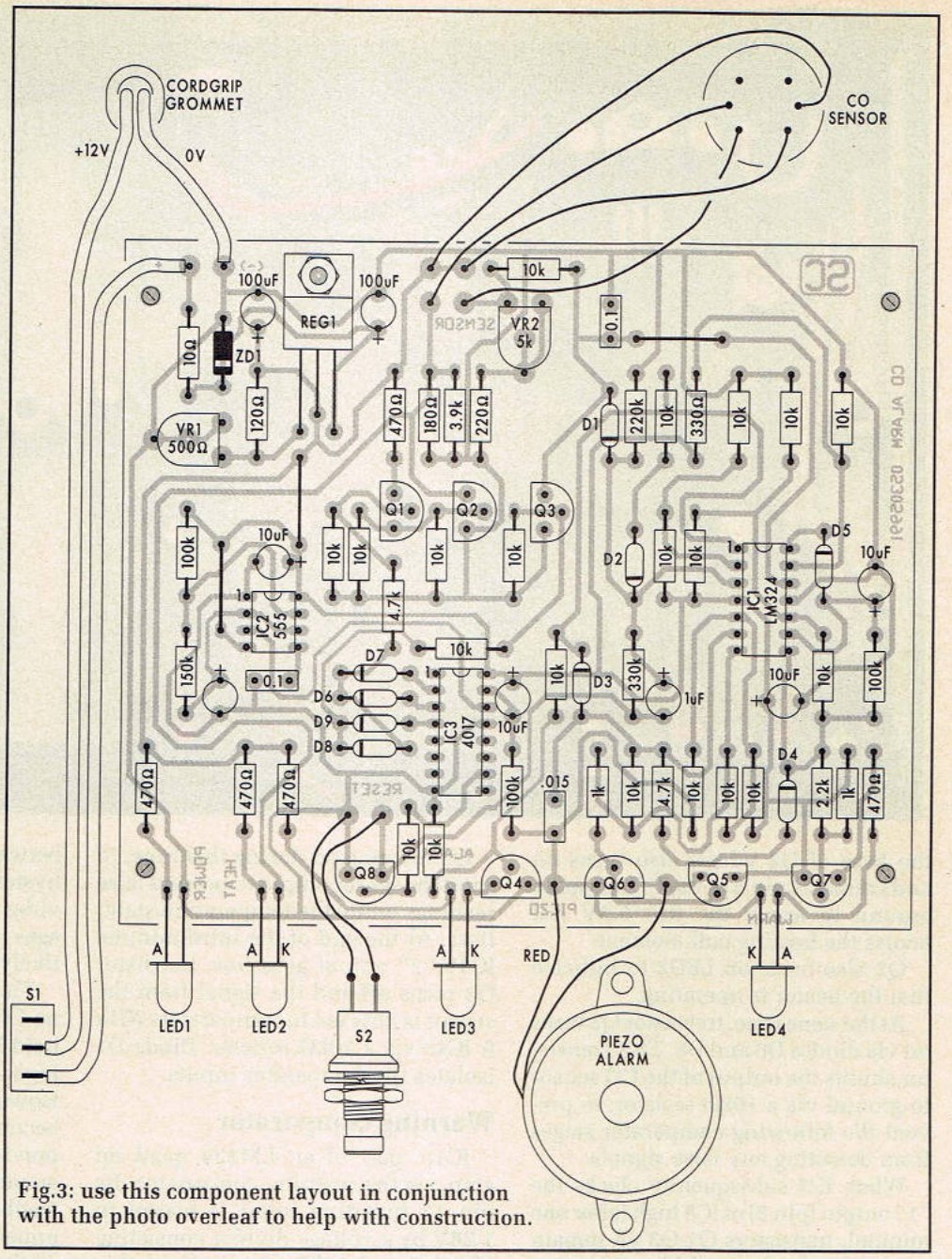
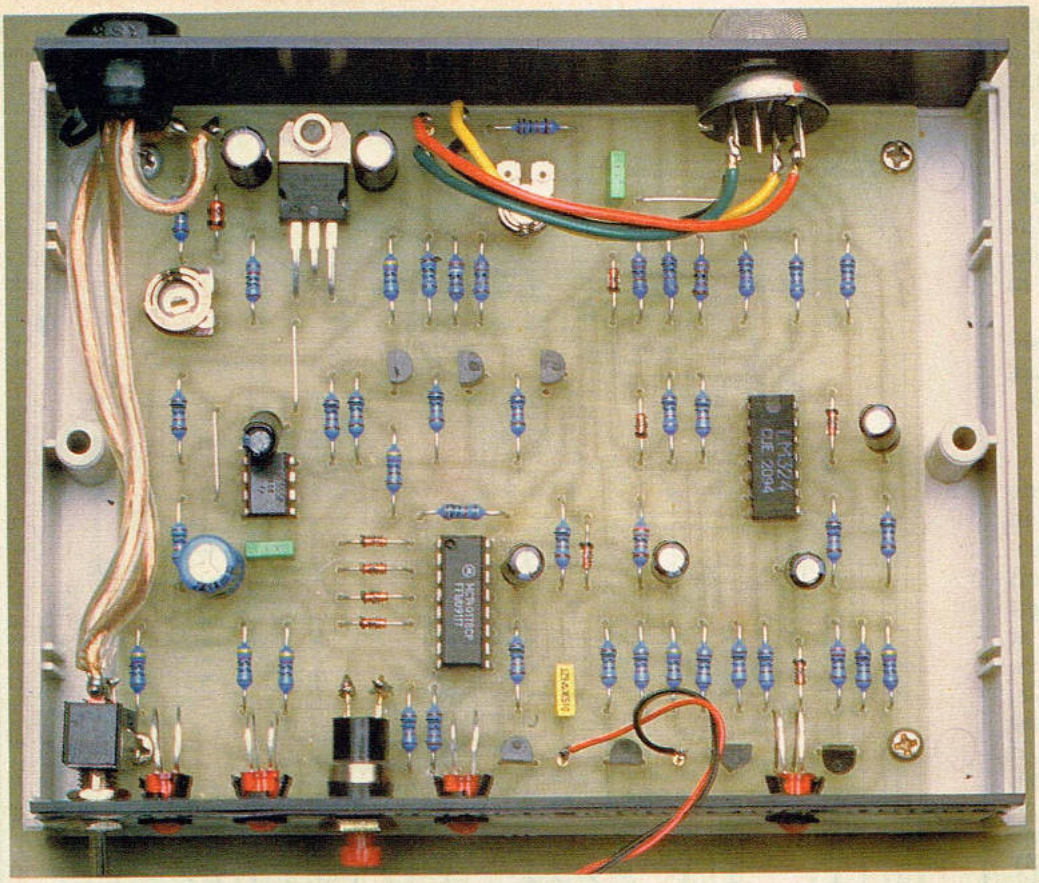


Fig.3: use this component layout in conjunction with the photo overleaf to help with construction.



This photograph of the completed project, looking from front to back, gives you a good idea of how large the project is. It will also help with component placement during assembly.

the base of Q2 which also turns on and connects pin 6 of the CO sensor to ground to apply the full 5.5V rail across the heating coil element.

Q2 also turns on LED2 to indicate that the heater is operating.

At the same time, transistor Q3 turns on via diodes D6 and D8. This transistor shunts the output of the CO sensor to ground via a 10kΩ resistor, to prevent the following comparator stages from detecting any false signals.

When IC2 subsequently clocks the "1" output (pin 2) of IC3 high (after one minute), transistors Q1-Q3 all remain on due to the forward bias now provided via diode D7. At the end of the second minute, the "2" output (pin 4) of IC3 switches high and forward bias to Q3 is supplied via D9. Conversely, D8 is reverse biased and so Q1 & Q2 switch off to end the heating (purge) cycle after two minutes.

Note, however, that a residual current still flows through the heater coil to ground via the parallel 180Ω and 3.9kΩ resistors on pin 6 of the sensor. The effective voltage across the heating coil is now only 0.8V and so the temperature quickly drops towards the desired 130-170°C operating range for CO sensing.

Q3 remains on during this time, to short the sensor output to prevent false readings while the temperature stabilises. At the end of the third minute, IC3's "2" output goes low, transistor Q3 turns off and the signal from the sensor is now fed to comparators IC1a & IC1c via a 10kΩ resistor. Diode D1 isolates the comparator inputs.

Warning comparator

IC1c, part of an LM324 quad op amp, is the warning comparator. Its pin 13 inverting input is biased to 1.28V by a voltage divider consisting of 33kΩ and 10kΩ resistors and this sets the comparator threshold. The output from the CO sensor appears at pins 5 & 7, while trimpot VR2 sets the sensitivity.

Normally, when CO concentrations are low, the output from the sensor is less than the comparator theshold voltage (1.28V). As a result, pin 14 of IC1c is low and D5 pulls pin 9 of IC1d low to prevent this flasher oscillator from operating.

Conversely, if the CO sensor output rises above 1.28V (ie, if excessive CO is detected), the voltage on pin 12 of IC1c will be greater than the voltage on pin 13.

When this happens, pin 14 of IC1c switches high and reverse biases D5, thereby allowing the flasher oscillator based on IC1d to operate.

IC1d is also part of the LM324 quad op amp package and is wired as a 0.5Hz oscillator. Its period of oscillation is set by the 100kΩ feedback resistor between pins 8 & 9 and by the associated 10µF timing capacitor. The two 10kΩ resistors on pin 10 nominally bias the non-inverting input to half supply ($^1/_2$ Vcc), while the 10kΩ feedback resistor between pin 8 and pin 10 provides hysteresis. This feedback resistor provides upper and lower threshold voltages of +3.67V and +1.83V respectively.

The circuit works as follows. When no CO gas is present, pin 9 of IC1d is held low and so the output at pin 8 is high and PNP transistor Q7 is off. However, if CO gas is detected, D5 becomes reverse biased as described previously and so the 10µF capacitor on pin 9 of IC1d charges via the 100kΩ feedback resistor until it reaches the upper threshold voltage (ie, 3.67V). At this point, pin 8 switches low and so Q7 turns on and lights LED 4 via a 470Ω resistor.

The 10µF capacitor now discharges via the 100kΩ feedback resistor into pin 8 until it reaches the lower threshold voltage (1.83V). When it reaches this point, pin 8 goes high again, Q7 turns off and the 10µF capacitor again starts charging towards the upper threshold voltage. This cycle continues indefinitely and so LED4 flashes at a 0.5Hz rate while ever CO gas is present.

Latching comparator

IC1a is the latching comparator. Its

pin 1 output switches high when the sensor output reaches half supply (ie, 2.25V), as set by the two 10kΩ bias resistors on pin 2. This high output in turn pulls pin 3 high via D2 and a series 10kΩ resistor and so the comparator output is latched high, even if the sensor output immediately drops below 2.25V. This turns on Q4 which in turn lights LED3 (alarm).

Note that when pin 3 of IC1a is latched high, D1 is reverse biased. This ensures that the high on pin 3 has no affect on the sensor output.

As soon as pin 1 of IC1a switches high, D3 is also reverse biased and so IC1b starts oscillating. This "tone generator" stage works in exactly the same way as the oscillator based on IC1d, except that the timing components on its pin 6 input are much smaller in value. As a result, IC1b oscillates at about 3kHz.

IC1b drives Q5 & Q6 which together function as a push-pull output stage. In turn, these drive the piezo alarm to provide the audible alarm. Note, however, that the 3kHz alarm tone is not continuous but is modulated by IC1d. That's because each time the output of IC1d switches low, it also pulls pin 6 of IC1b low via D4 and a series 4.7kΩ resistor and thus disables the tone generator. IC1d oscillates at a 0.5Hz rate, which means that the tone generator stage (IC1b) operates in 1-second bursts.

The latching comparator can be reset at any time by pressing the Reset switch S2. This momentarily pulls pin 3 of IC1a low via a 1µF capacitor. If the voltage from the CO sensor is below the latching comparator threshold, then the comparator output stays low and the circuit reverts to the monitoring status. If not, it will go high again immediately after the reset and retrigger the alarm.

Alternatively, if the Reset button isn't pressed, the latching comparator is automatically reset when the "4" output (pin 10) of IC3 goes high and switches on transistor Q8. This occurs one minute into the sensing period (ie, at the end of the fourth minute).

As for a manual reset, the alarm is immediately retriggered if the sensor output is still above IC1a's threshold voltage; otherwise it resumes its monitoring role.

If the alarm immediately retriggers after the automatic reset, it will continue to sound until IC3's "4" output switches high again 10 minutes later. This means that the alarm will even continue to sound during the next heat purging period (unless, of course, the reset button is pressed). When the heat purging process starts, however, Q3 turns on and so pin 14 of IC14 goes low. As a result, oscillator IC1d is disabled which means that it no longer drives LED 4 (via Q7) or modulates the audible alarm.

Therefore, the audible alarm switches from pulsed to continuous tone when the heat purging cycle begins. Pressing the Reset switch will now turn the alarm off, since the sensor output is effectively grounded by Q3 and can no longer retrigger the latching comparator.

Note that the heat purging process does not start until six minutes after the automatic reset has taken place. That's because IC3 is a decade counter and it takes a further six minutes for outputs "5-9" (not shown on the circuit) and then "0" to go high in turn.

Construction

Building the CO Alarm is easy since virtually all the parts are mounted on a single PC board coded 05303991 (117 x 102mm). Fig.3 shows the assembly details.

Before installing any of the parts, carefully check your PC board for etching defects by comparing it with the published pattern. In particular, check for shorted or broken tracks and undrilled holes.

Begin the assembly by installing the three wire links, then install PC stakes at the external wiring points. You will need 10 PC stakes in all – four for the CO sensor leads, two for the power supply connections, two for switch S2 and two for the piezo alarm.

Once the PC stakes are in, you can install all the resistors. Table 2 shows the resistor colour codes but it's also a good idea to check them using a digital multimeter, just to make sure. The three ICs can then be installed, followed by the diodes and the zener diode. Make sure that these semiconductor parts are correctly oriented.

Now for the transistors. Be careful here, because there are three different types used and they all look the same. In particular, be careful not to confuse the BC327 and BC337 types (one is a

Parts List

1 Nemoto NAP-11A semiconductor type CO gas detector
1 PC board, code 05303991, 117 x 102mm
1 front panel label, 133 x 27mm
1 small instrument case, 110 x 140 x 35mm (see text)
1 automotive lighter plug
1 piezo transducer
1 SPDT toggle switch (S1)
1 momentary contact switch (S2)
1 1m length red/black figure-8 wire
1 60mm length 0.8mm tinned copper wire
1 80mm length yellow hookup wire
1 80mm length blue hookup wire
1 160mm length red hookup wire
1 cordgrip grommet
10 PC stakes
4 5mm LED bezels
2 3mm screws and nuts
4 small self-tapping screws to secure PC board

Semiconductors
1 LM324 quad op amp (IC1)
1 555 timer (IC2)
1 4017 divide-by-ten decoder (IC3)
1 LM317T adjustable regulator (REG1)
2 BC547 NPN transistors (Q1,Q8)
4 BC337 NPN transistors (Q2-Q5)
2 BC327 PNP transistors (Q6,Q7)
1 16V 1W zener diode (ZD1)
9 1N914, 1N4148 switching diodes (D1-D9)
4 5mm red LEDs (LED1-LED4)

Capacitors
1 220µF 16VW PC electrolytic
2 100µF 16VW PC electrolytic
4 10µF 16VW PC electrolytic
1 1µF 16VW PC electrolytic
2 0.1µF MKT polyester
1 .015µF MKT polyester

Resistors (0.25W, 1%)

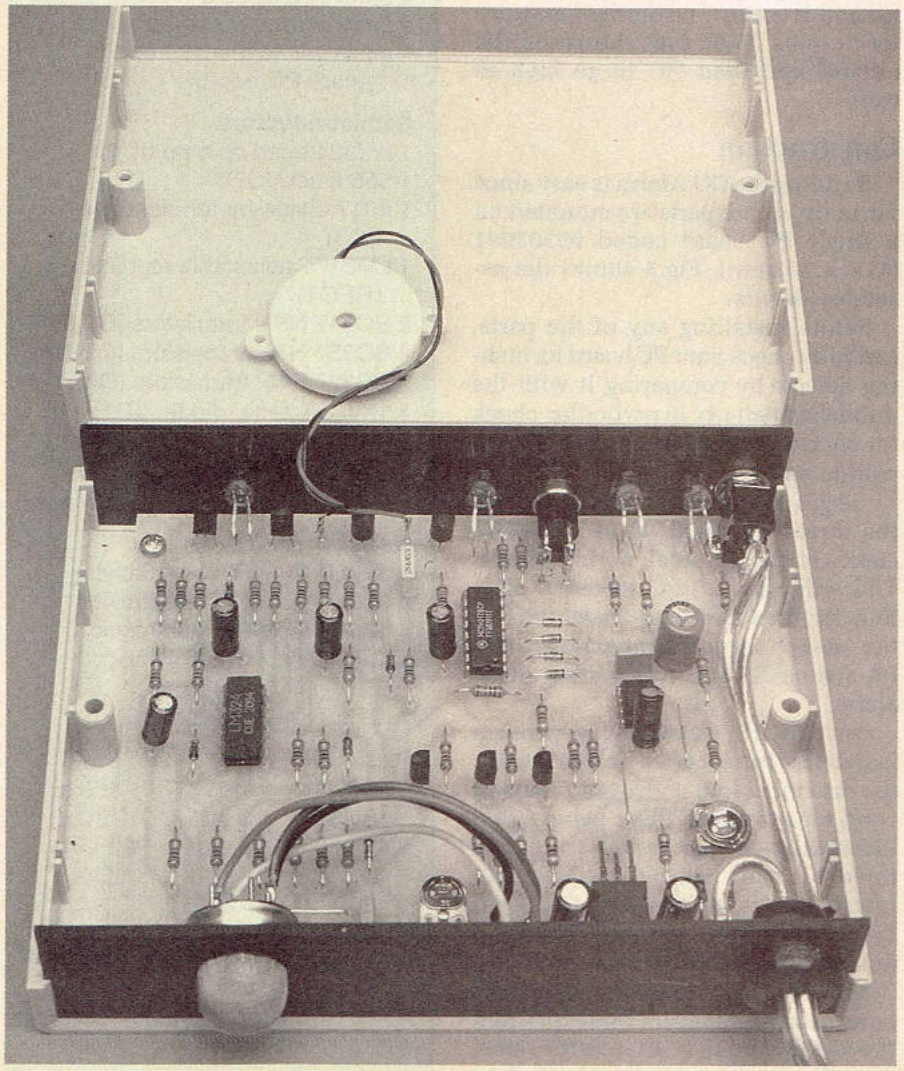
1 330kΩ	1 220kΩ	1 150kΩ
3 100kΩ	1 33kΩ	19 10kΩ
2 4.7kΩ	1 3.9kΩ	1 2.2kΩ
2 1kΩ	5 470Ω	1 330Ω
1 180Ω	1 120Ω	1 10Ω

1 500Ω horizontal trimpot (VR1)
1 5kΩ horizontal trimpot (VR2)

Miscellaneous
Solder, etc

Table 2: Resistor Colour Codes

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	330kΩ	orange orange yellow brown	orange orange black orange brown
❑	1	220kΩ	red red yellow brown	red red black orange brown
❑	1	150kΩ	brown green yellow brown	brown green black orange brown
❑	3	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	33kΩ	orange orange orange brown	orange orange black red brown
❑	18	10kΩ	brown black orange brown	brown black black red brown
❑	2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	3.9kΩ	orange white red brown	orange white black brown brown
❑	1	2.2kΩ	red red red brown	red red black brown brown
❑	2	1kΩ	brown black red brown	brown black black brown brown
❑	5	470Ω	yellow violet brown brown	yellow violet black black brown
❑	1	330Ω	orange orange brown brown	orange orange black black brown
❑	1	180Ω	brown grey brown brown	brown grey black black brown
❑	1	120Ω	brown red brown brown	brown red black black brown
❑	1	10Ω	brown black black brown	brown black black gold brown



And here is the final assembly, looking from the rear. The round grey object on the bottom left is the CO sensor, which could be mounted external to the case.

PNP transistor, the other an NPN type). Note that Q8 needs to be bent over flat on the PC board to allow room for the Reset switch.

Next, install the capacitors and note that the electrolytic types must be oriented correctly. Table 3 shows the value codes for the MKT polyester types.

Regulator REG1 has its leads bent at right angles so that it can be mounted with its metal face flat against the PC board. Bend the leads as shown in the photo, so that they mate with the board mounting holes, then secure the regulator to the board using a screw and nut before soldering the leads. A separate heatsink isn't required for REG1 – its metal tab allows sufficient cooling.

The board assembly can now be completed by installing VR1, VR2 and the four LEDs. Mount the LEDs with a 20mm lead length so that they can later be bent over and pushed through the bezels fitted to the front panel. Make sure that the LEDs are correctly oriented – the anode lead is the longer of the two. In particular, note that LED4 is oriented differently to LEDs 1-3.

Case

As previously discussed, the prototype CO Alarm was housed in a low-profile instrument case measuring 110 x 140 x 35mm.

Whether or not you use this case is up to you and your particular method of mounting. If you do, you will have

Table 3: Capacitor Codes			
	Value	IEC	EIA
❑	0.1µF	104	100n
❑	.015µF	153	15n

to drill four holes in the front panel to take the switches, plus four more to accept LED mounting bezels. Another two holes are drilled in the rear panel for the cordgrip grommet and CO sensor.

First, the front panel. The best way to go about this job is to attach the label and then use this as a guide for drilling the holes. Alternatively, you can use the full-size artwork published with this article as a drilling template.

Take care with the holes in the rear panel – both the sensor and the cordgrip grommet (for the 12V supply leads) should be a tight fit. The best way to make the sensor hole is to first drill a small pilot hole and then carefully enlarge it to size using a tapered reamer. The other hole should be carefully profiled to suit the shape of the cordgrip grommet.

The PC board can now be installed in the case and secured using four self-tapping screws. These go into the integral standoffs in the base of the case. This done, mount the switches on the front panel, then slide the panel into its slot at the front of the case and push the indicator LEDs through their matching bevels.

All that remains now is to complete the wiring as shown in Fig.3. Use automotive cable for the supply leads and make sure these are firmly secured to the rear panel using the cordgrip grommet.

The CO sensor can be wired using light-duty hookup wire, while switch S2's contacts solder directly to the PC stakes adjacent to Q8.

We mounted the piezo transducer on the lid of the case using hook and loop fasteners but a dab of super glue would also work. Finally, attach a cigarette lighter plug to the 12V supply lead.

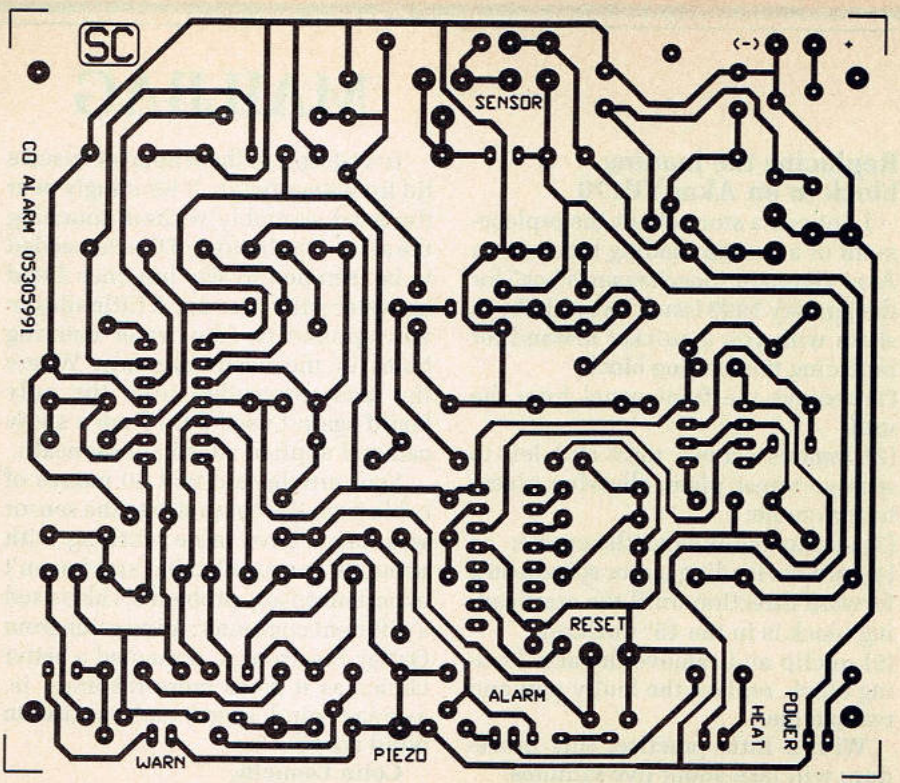


Fig. 4: use this same-size PC board pattern to make your own board or to check a commercial board for etching/drilling defects before commencing assembly.

Testing

You're now ready for the smoke test. Rotate VR1 fully anticlockwise, apply power to the circuit and measure the voltage on the output (centre) lead of REG1.

Adjust VR1 for a reading of 5.5VDC and check that both LED1 and LED2 are now alight, indicating that power is present and that the heating cycle has begun.

If LED2 fails to light, try switching the power off and then on again, to activate the power-on reset for IC3. If that fails, check the 5.5V rail on pin 4 of IC1, pin 8 of IC2 and pin 16 of IC3.

Assuming that all is well, wait for two minutes and check that the Heat LED (LED2) extinguishes. If you want to check operation of the sensor, place it near the exhaust pipe outlet of a running engine. Both the CO warning LED and the main alarm should be activated after a short time.

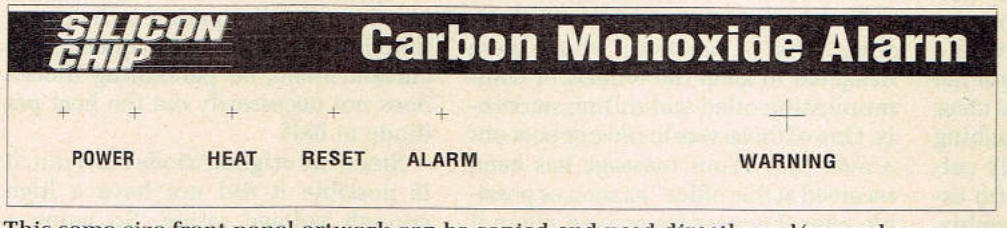
Switch the power off and on again if you want to initiate the heat purging sequence immediately. This will also stop the main alarm if it has latched on.

Installation

The CO alarm is installed inside the vehicle and can be placed on the dashboard. Note that if you are already using the lighter socket for some other purpose, you can obtain a double lighter socket from automotive retailers or from Jaycar.

VR2, the sensitivity control, should initially be set to mid-position and this should suit most applications.

If you want greater sensitivity, adjust VR2 anticlockwise. Conversely, to decrease the sensitivity (eg, if the unit generates lots of nuisance alarms), adjust VR2 clockwise from its mid-position. **SC**



This same-size front panel artwork can be copied and used directly and/or used as a drilling template for the front panel. Artworks for panels and PC boards are also available on the SILICON CHIP website, www.siliconchip.com.au

MAILBAG

Replacing the loading block in an Akai VP170

I noticed a story about the replacement of a broken loading block in an Akai VP170 in "Serviceman's Log" for the January 1999 issue. I would like to share with you a quicker method for replacing the loading block:

(1) remove the front panel from the unit;

(2) remove screws right and left to remove upper plate, allowing access to the cradle;

(3) unclip and remove the cradle;

(4) turn the loading motor spindle in a forward direction until the arm loading block is in the 45° position.

(5) unclip and remove the arm loading block, replace the faulty part and reassemble.

With a little practice, this procedure will take about five minutes.

T. Cairney,
Mt. Gravatt, Qld.

Modifications to Anemometer

Thank you for producing a brilliant project in the wind speed meter in the March 1999 issue. I have constructed it and it works very well. There were some modifications I have made which may be of interest to your readers.

Living in a small town in North Queensland has some disadvantages. When I asked the local bike shop about secondhand alloy wheel hubs they looked at me with a blank stare and said no! You can only buy them new and attached to the rest of the wheel at a cost of about $150. Strike one wheel hub as a bearing assembly.

A rummage around in the junk bin uncovered a failed video head assembly with upper and lower drum complete. This has to be the best thing to use as it is entirely made of alloy and stainless steel. After removing the drive magnet and circuit board, the heads and attached PC board and the inner rotary transformer, it was clear it would work perfectly. By attaching the lower half to a piece of poly cutting board and attaching the arm assembly to the upper head assembly, the thing spun quite freely.

To waterproof the whole lot I used a lid from a spray can. It fits snugly over the head assembly without touching the sides. The bottom of the lid needed to be trimmed to size but once fitted no water will come up. A little silastic was applied to stop water entering holes in the head assembly. Where the shaft protruded from the poly board again I used a lid from a spray can and applied silastic underneath.

Your article said that 10 metres of cable from the computer to the sensor was OK. I have mine working with about 20 metres of cable and haven't experienced any problems. I also used a different computer; mine came from Oatley Electronics. It seemed a better choice as it gives more readings; ie, average wind speed and maximum wind speed.

Colin Leonelli,
Ingham, Qld.

HTML files are a pest

I read your Publisher's Letter regarding email in the February 1999 edition with great interest. Yes, indeed, there are a lot of people out there who make it difficult for us to read the email they send. The one you forgot to mention is the person whose message is in HTML format littered with formatting commands that make it almost impossible to find the text in the middle of it.

But sometimes the boot is on the other foot, especially with the way people answer their email. You tell us how the answer to a message may not be immediately available ("it might not get answered for a week or two") but is the sender advised that there may be a delay? Most people just hold onto the message until it can be answered but give no indication whether it was received or lost in transit.

Back in the "Good Old Days", there were a lot of practices which were designed to keep the wheels of communication oiled and rolling smoothly. One of these was to *always* post out a note that "Your message has been received at this office" as soon as possible after the message arrived when it looked as though an answer could not be given right away.

Of course this meant the sending of two replies and this practice ceased at about the same time that people stopped mailing out a receipt for payments by mail, when the cost of a stamp was considered more valuable than customer relations. But in these days of email, when the cost of sending a reply is no more than the time to write it, perhaps it is time to revive the practice.

G. Mayman,
Dover Gardens, SA (via email).

Comment: good point. We are now answering most email within a day or two but where there will be a longer delay we are giving immediate acknowledgement.

High voltage diodes get hot

In the "Serviceman's Log" story on a Masuda T092 in the April 1999 issue, you refer to the amazing heat from a 1000V FR607 rectifier, used to replace a 600V FR605.

The reason is that the higher the voltage, the thicker the "intrinsic" layer in a high-voltage rectifier, and the slower the recovery time. Listings in a Diodes Incorporated catalog suggest that at the lower voltages in the FR60X family, this will be 150ns, rising to 250ns at 600V and 500ns at 800V (this particular company apparently does not make the 1000V FR607, which might be slower still). In other words, things can get bad rather quickly as the top voltage of a particular process is approached.

A horizontal circuit is (in part) a switching supply and a slower recovery time means more heat. For example, an ordinary 6A 600V rectifier put into the circuit would probably short circuit instantly and take several other components with it. Note that switching-recovery dissipation is in part a function of voltage and frequency, not current alone, so paralleling diodes does not necessarily cut the heat per diode in half.

Since the original diode blew out, it is possible it did not have a high enough voltage rating. So using a higher voltage part may well not have

been a mistake. But extra heat would not be surprising; the recovery time may well be three times as long as with the original diode.

There are other diode processes, such as "FRED", that offer faster recovery times at high currents and voltages. The DigiKey catalog lists some Ixys devices at 8-12A and 35ns at 600V and 50ns at 1000V. (These families are faster than the FR60X but within a given family, the highest voltage ones still recover more slowly.) Of course, these are newer parts and come only in TO-220 and TO-247 packages (which have a large metal tab or pad at the potential of one of the leads) and not the cylindrical package, so depending on board layout, it might or might not be safe to use them.

Paul Schick,
Madison, WI, USA.

Alternator speed & frequency

With reference to the letter from Mr K. Russell of Willaston, SA, in the March 1999 issue concerning alternator speed and frequency, I would like to provide the following information.

I am no expert in the Vestas system but it is my understanding that the Vestas wind turbines are induction alternators (asynchronous machines). An induction alternator is basically an induction motor that is driven above its synchronous speed. The power output curve of an induction machine reaches a maximum for rotational power out (ie, motor mode) at a speed approximately 1-5% below its synchronous speed. At around 1-5% above synchronous speed, the electrical output (ie, generator mode) will be a maximum.

Based on the information provided in your article, the Vestas machines are 4-pole machines which provides a synchronous speed of 1500rpm with Australia's 50Hz system. The operating range is 1500-1560 RPM which is 0-4% above synchronous speed.

As a related issue, induction machines require an input of reactive power to produce an electrical output and cannot therefore provide nett reactive power to the electrical network, as can the synchronous machines that are employed in most large power stations. Any electrical machine can be used as a generator by driving the shaft that is normally driven in motor mode.

In the case of an induction motor used in isolation from the electricity grid, an alternative source of reactive power is required. This is often provided by means of capacitors, similar to those used by electricity distribution companies to provide for system voltage control.

A final point concerning Mr Russell's comments about your graphs. Mr Russell has assumed that there is a linear relationship between wind speed, generator rotational speed and power output. This is not the case and in fact the power available from the wind varies in proportion to the cube of the wind speed. Therefore the graphs will not "superimpose" unless the vertical scales are changed to reflect this non-linear relationship between the quantities.

Andrew Russack,
Highgate, SA.

More on AC alternators

In response to your correspondents' letters in the March 1999 issue, regarding AC alternators' speed and their relationship to generated frequency, I take this opportunity to clarify the differences between synchronous and asynchronous generators. A standard synchronous alternator's rotor has fixed magnetic poles that are "locked" into synchronism with the supply frequency. It would appear that the "alternators" mentioned in the Wind Power article in the January 1999 issue are not of the synchronous type but are "induction generators". These are no more than AC induction motors whose rotors run at a speed in excess of synchronous speed (the speed governed by the frequency of the supply grid).

A standard induction motor's rotor normally runs at a few percent less than synchronous speed (the speed difference known as slip) to enable the rotor windings to cut the stator's field and produce the required rotor current needed to produce torque. In doing so, a motor consumes electrical energy from the supply.

If the same rotor has its speed increased to synchronous speed (by some external mechanical means), the energy flow stops since the rotor windings no longer cut the stator field at "zero slip". It follows then that if the rotor speed is increased further, a "negative slip" condition exists and the energy flow is reversed. The machine now generates back into the grid system (the mechanical energy is being converted to electrical energy). Thus the critical speed/frequency/poles relationship does not apply.

The beauty of the induction generator is that it does not require initial synchronising to the grid; it is merely a matter of running up to a speed slightly greater than synchronous speed and closing the supply circuit switch. There is, however, one main drawback in that the supply must normally (but not necessarily) be available for the machine to close on to, since an induction generator usually derives its field from the running grid.

Todd's Corner Power Station in Tasmania's central highlands operates in this manner.

T. Ives, Penguin,
Tasmania.

Bass cube rear panel should not be glued

I have read the article on the Bass Cube in the April 1999 issue and congratulate you on what appears to be an excellent project for the home audio market. However, I have one question which I can not answer.

The article appears to say that the only access to service the driver is glued into the box (last paragraph on page 43). Looking at the photographs the driver appears to be mounted inside the box. I have been in the audio industry for many years, servicing all types of amps and speakers, including re-coning brands of speakers such as Altec Lansing, JBL, Electro-Voice, Klipsch, Cerwin Vega, Wharfdale, etc.

I have never seen a box where it is virtually impossible to remove the speaker for service (well, almost never – some Bose units have the speakers glued into the box with hot melt glue!). Your article states that the manufacturer may not honour the speaker warranty if the wires are soldered to the speaker (strange!) but if the speaker can not be removed from the box, I

continued on page 77

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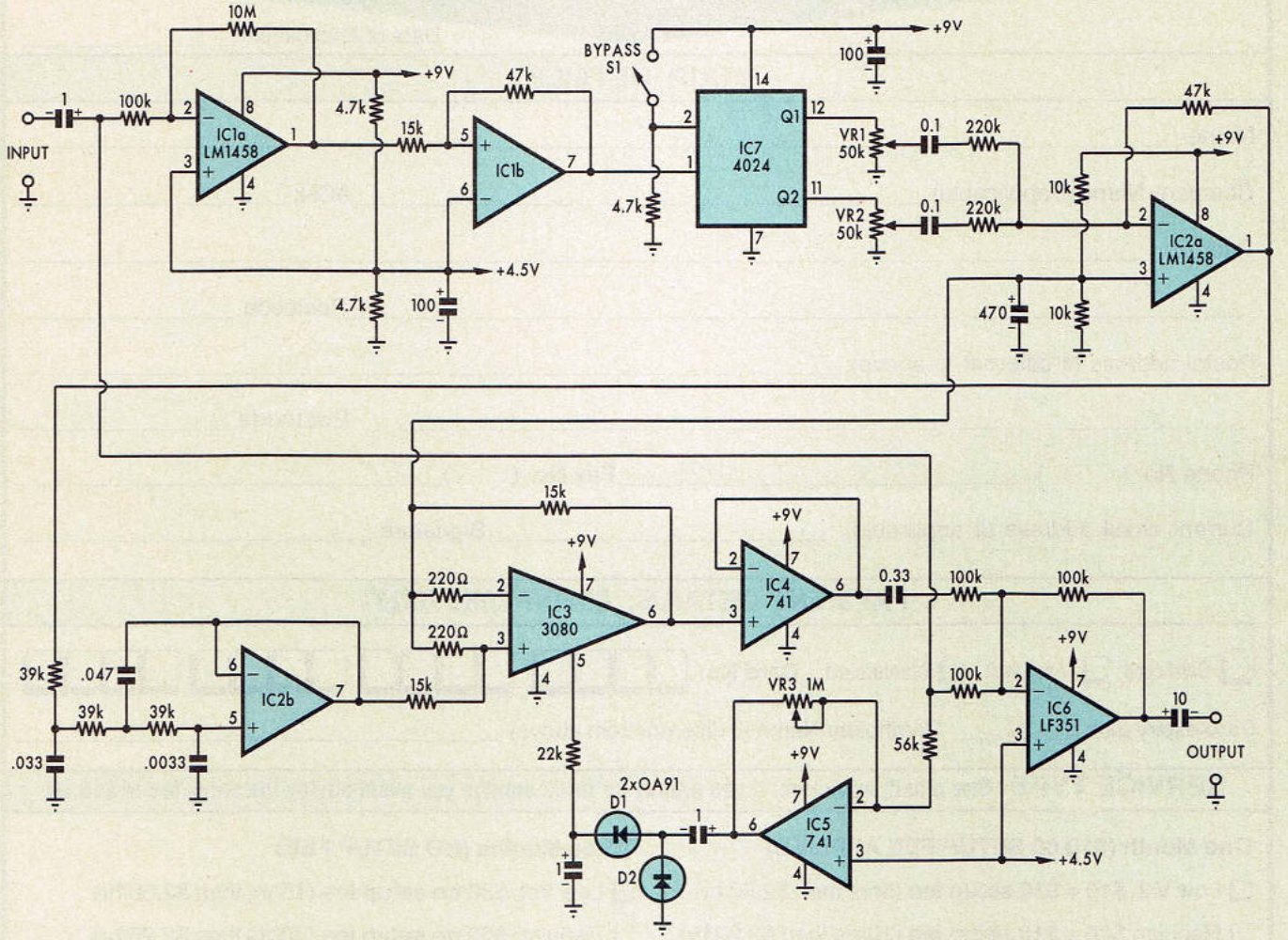
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Add bass harmony to a guitar

This circuit was developed for use with a guitar although other instruments or sound sources could be used. The circuit divides the input frequency and produces an output that consists of the original input signal plus sub-harmonics at one and two octaves below.

In essence, the input signal is amplified by op amps IC1a and IC1b and the resulting clipped signal is used to clock IC7, a 4024 7-stage binary counter. Subharmonic outputs are then taken from the Q1 and Q2 outputs of IC7 and fed via pots VR1 and VR2 to a mixer stage employing IC2a, followed by a low-pass filter stage comprising IC2b.

The composite filtered sub-harmonic signal is then fed to a 3080 transconductance amplifier which automatically controls the gain according to the signal amplitude at the input. Note that the input signal is also fed to IC5, a 741 op amp which feeds a rectifier consisting of diodes D1 and D2, together with two 1µF capacitors. This rectifier feeds the control input on the 3080.

The signal from the 3080 is buffered by IC4 and then mixed with the input signal in IC6. The bypass switch S1 allows the effect to be switched in and out.

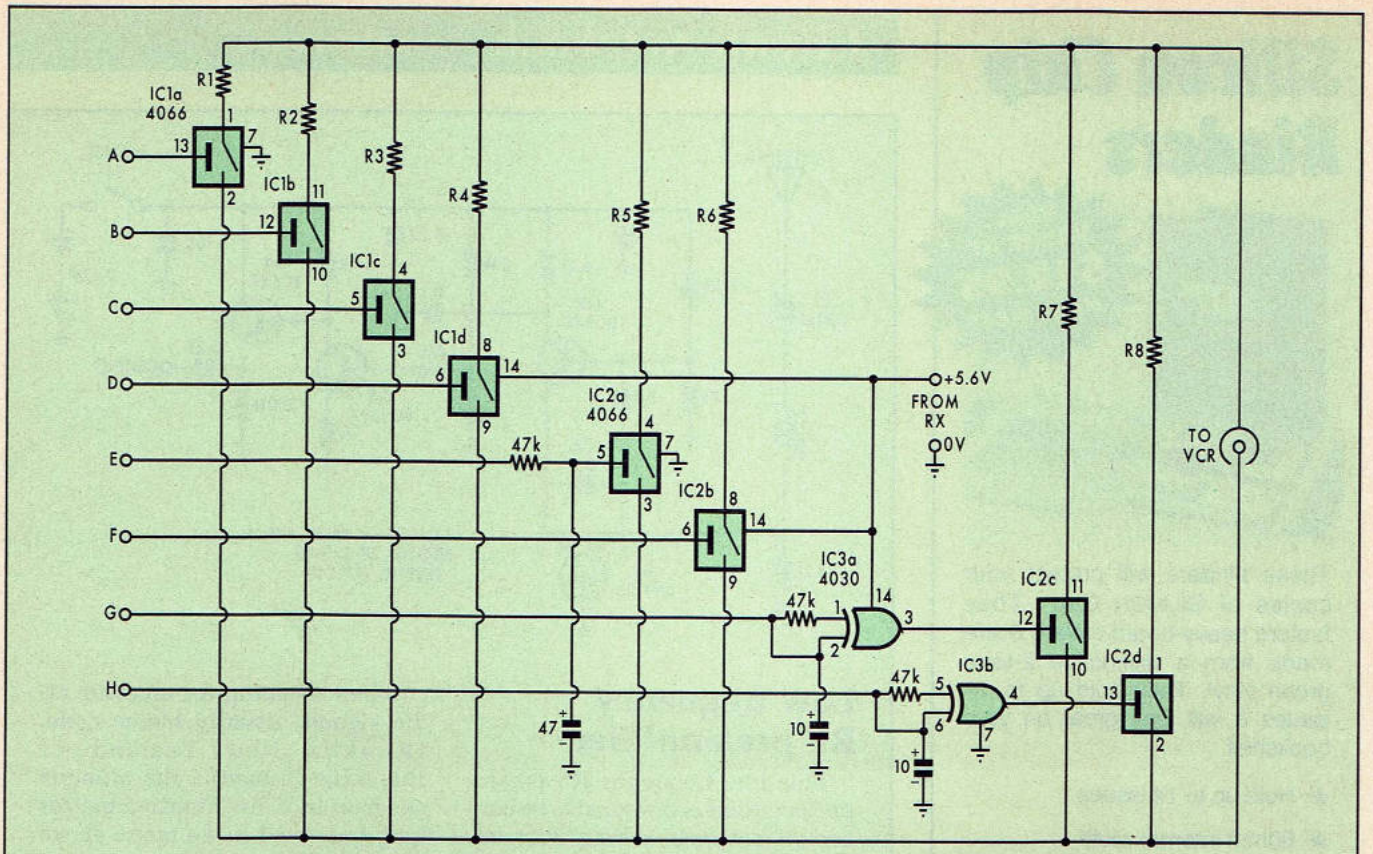
Setting up requires a little trial and error to find the correct setting for VR3 which sets the voltage gain. Start by setting it midway and then adjust it so that the low bass notes are not clipped or sound distorted but are sufficiently loud.

The circuit runs on a single 9V battery and draws around 5mA.

S. Williamson,
Hamilton, NZ. ($40)

Add remote control to an old VCR

Yes, it is possible to add infrared remote control to any old VCR which has a two-wire remote control. To do it, you need to use this simple circuit together with the 8-channel IR remote



OUTPUT FUNCTION & R	A STOP R1	B PAUSE R2	C REW R3	D FF R4	E REC R5	F PLAY R6	G CH UP R7	H CH DN R8
THORN TR102 AWA AV-12	8.2k	0	27k	18k	56k	39k	82k	100k
NEC N901A	8.2k	18k	20k	24k	39k	56k	12k	10k
SHARP VC-481 PHILIPS VR6440	1.2k	56k	2.7k	4.7k	12k	8.2k	—	—
HITACHI VT-33E	2.2k	0	3.3k	4.7k	56k	100k	470Ω	—
JVC HR7200 RANK ARENA RV340 GE V6900	18k	10k	82k	33k	390Ω	3.9k	0	—
NATIONAL NV300	0	10k	1k	3.9k	56k	100k	—	—
NATIONAL NV370	0	10k	1k	2.2k	56k	120k	—	—

control described in the February 1996 issue of SILICON CHIP. No modification is required to the VCR itself.

As described in the February 1996 article, the IR receiver circuit has eight outputs, A to H. The first six are momentary, while the other two are latched outputs.

Table 1 (under the circuit) shows the functions provided by a selection of VCR models, together with the resistance values needed to select each function. On the circuit, resistors R1 to R8 must be chosen from this table to suit the type of VCR.

The switching is done using each gate of a 4066 analog switch (IC1 & IC2). Fortunately, the nominal 90Ω on-resistance of these gates is low enough not to be a problem for the VCR models shown.

Outputs A, B, C, D and F directly drive the control inputs of IC1 and IC2b respectively. Output E (used for the record function) drives switch IC2a via an RC delay circuit. This means line E has to stay high for about two seconds before IC2a will switch on. This ensures that the Record mode cannot be accidentally activated.

The latched outputs G and H have been used to control the Channel Up and Channel Down VCR functions but these needed a little modification to make them useful. Exclusive-OR gates IC3a and IC3b are configured as edge-detectors to provide a short positive-going pulse in response to each press of the corresponding button on the transmitter. Each pulse momentarily closes the corresponding CMOS switch (IC2c or IC2d) to activate Ch.Up or Ch.Dn. Note that some early VCRs did not have remote channel-changing ability.

Power for the circuit comes from the IR receiver PC board (from the emitter of Q2), giving a nominal supply rail of 5.6V.

Chris Dunn,
Nowra, NSW. ($50)

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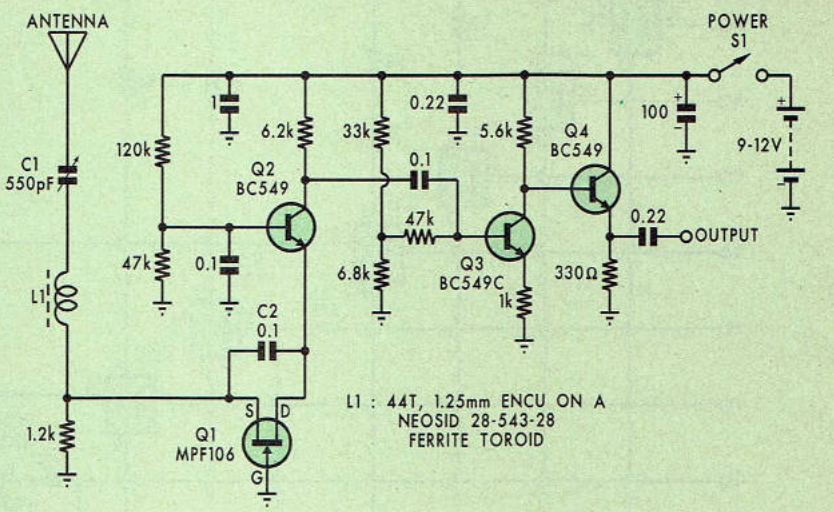
Circuit Notebook – *continued*



Low frequency RF preamplifier

This low frequency RF preamplifier circuit is designed to be connected between a long wire antenna and a low frequency receiver. It was designed for listening to low frequency airport beacons and amateur radio low frequency signals.

There is only one control to adjust and that is variable capacitor C1 which provides a series resonant circuit with the antenna at the required frequency.

When listening for amateur radio signals, usually Morse code, 181.4kHz New Zealand or 176.5kHz Tasmania, the antenna needs to be a few hundred metres long and about half a metre above the ground, facing end-on to the incoming signal.

Q1 and Q2 can be regarded as a cascode stage with the output being taken from the collector of Q2. Further gain is provided by Q3 which is then buffered by the emitter follower stage, Q4.

R. Milne, Moonah, Tasmania. ($25)

Simpler metering circuit for capacitance meter

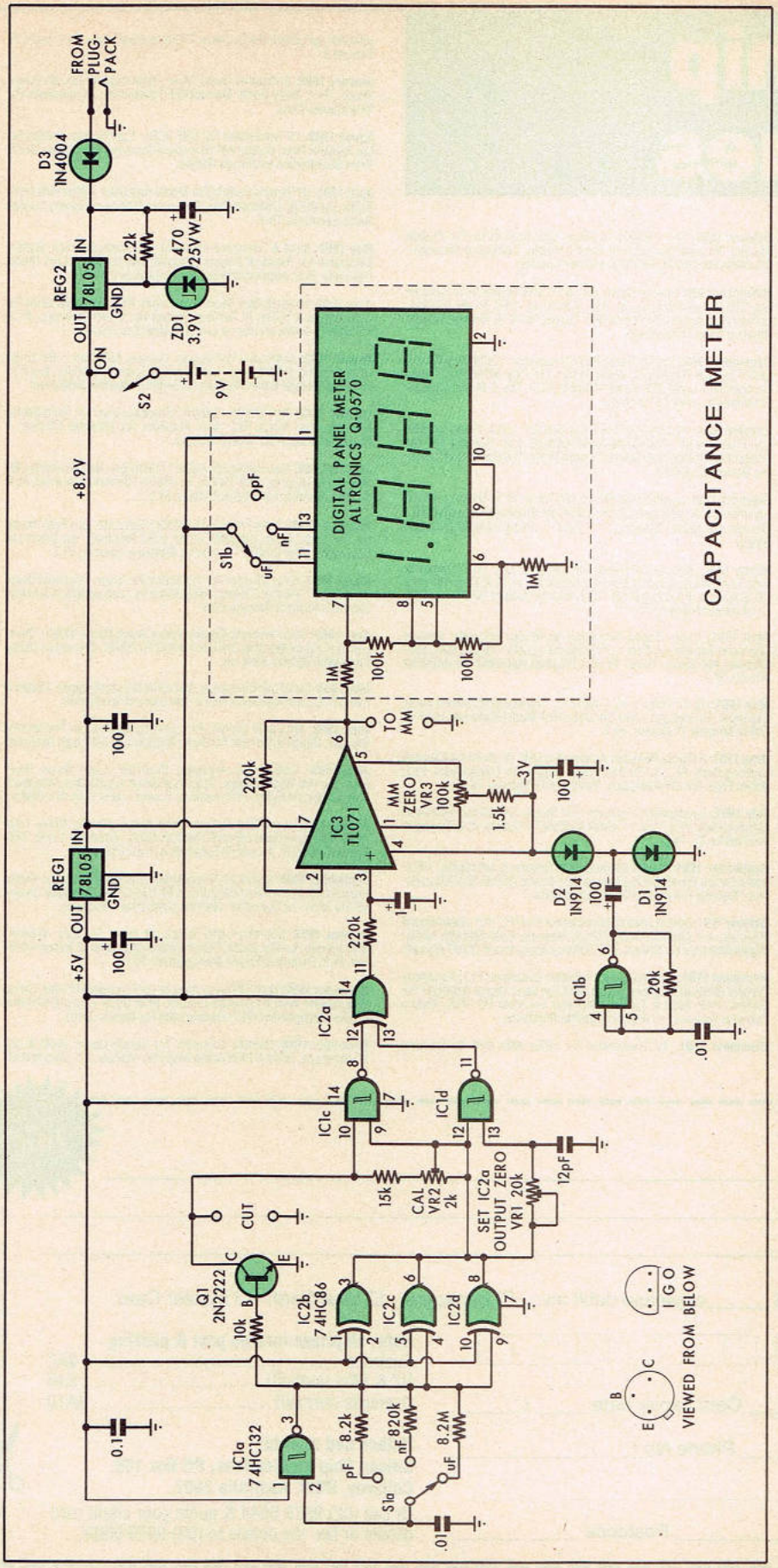
The Capacitance Meter published in the February 1999 of SILICON CHIP can be simplified with the release of a new LCD panel meter from Altronics in Perth.

This new panel meter has the advantage that it can share a common ground with the circuit it is measuring. This means that the level-shifting op amp (IC3) in the original capacitance meter circuit can be dispensed with. The simplified circuit is shown here and can be wired up on the original PC board. The new Altronics panel meter retails for $25 (Cat Q-0570).

SILICON CHIP

Circuit Ideas Wanted

Do you have a good circuit idea. If so, why not sketch it out, write a brief description of its operation & send it to us. Provided your idea is workable & original, we'll publish it in Circuit Notebook & you'll make some money. We pay up to $60 for a good circuit but don't make it too big please. Send your idea to: Silicon Chip Publications, PO Box 139, Collaroy, 2097.



Mailbag: continued from page 71

guess it doesn't matter how you connect the wires.

Forgive me if I have missed something in the article. I understand that the box has to be airtight but if I haven't, some form of rebate or front mounting of the driver is a more practical idea if it develops a fault.

Brad Sheargold,
Collaroy, NSW.

Comment: You are right. The rear panel should not be glued into place although some form of sealant should be applied before it is screwed down.

PIC programmer feedback

I have some feedback regarding the PIC programmer described in the March 1999 issue. I don't know if anyone else has had any problems with theirs but when running the sample program that I obtained from the Oatley website, two LEDs were cycled instead of one. This was puzzling until I realised that the carry bit from the STATUS register was carrying over, so to speak, at the "rlf" command. Execution of the command "bcf STATUS,7" clears bit 7 of the STATUS register prior to rotating the bits left and apparently fixes the problem.

Also, when starting the NOPPP program, the message, "Hardware not found" occurs although the programmer appears to function perfectly. Has anyone else had this message? Is it a software or hardware fault? Some feedback would be appreciated. Some tutorial articles examining the functions of the PIC16F84 and simple example code would be of great value to many of your readers.

Kerry Helman (via email).

Converting LCD calculators to 7-segment display

Can anyone advise me how the output of LCD calculators can be converted to run 7-segment LED displays? Obviously a separate power supply and LED display would be required and I am prepared to locate in a separate enclosure. Any assistance that your readers may be able to give would be much appreciated.

B. Allardice,
Cunnamulla, Qld.

Silicon Chip Back Issues

September 1988: Hands-Free Speakerphone; Electronic Fish Bite Detector; High Performance AC Millivoltmeter, Pt.2; Build The Vader Voice.

April 1989: Auxiliary Brake Light Flasher; What You Need to Know About Capacitors; 32-Band Graphic Equaliser, Pt.2; The Story Of Amtrak Passenger Services.

May 1989: Build A Synthesised Tom-Tom; Biofeedback Monitor For Your PC; Simple Stub Filter For Suppressing TV Interference; The Burlington Northern Railroad.

July 1989: Exhaust Gas Monitor; Experimental Mains Hum Sniffers; Compact Ultrasonic Car Alarm; The NSW 86 Class Electrics.

September 1989: 2-Chip Portable AM Stereo Radio (Uses MC13024 and TX7376P) Pt.1; High Or Low Fluid Level Detector; Studio Series 20-Band Stereo Equaliser, Pt.2.

October 1989: FM Radio Intercom For Motorbikes Pt.1; GaAsFet Preamplifier For Amateur TV; 2-Chip Portable AM Stereo Radio, Pt.2; A Look At Australian Monorails.

November 1989: Radfax Decoder For Your PC (Displays Fax, RTTY & Morse); FM Radio Intercom For Motorbikes, Pt.2; 2-Chip Portable AM Stereo Radio, Pt.3; Floppy Disc Drive Formats & Options; The Pilbara Iron Ore Railways.

January 1990: High Quality Sine/Square Oscillator; Service Tips For Your VCR; Phone Patch For Radio Amateurs; Active Antenna Kit; Designing UHF Transmitter Stages.

February 1990: A 16-Channel Mixing Desk; Build A High Quality Audio Oscillator, Pt.2; The Incredible Hot Canaries; Random Wire Antenna Tuner For 6 Metres; Phone Patch For Radio Amateurs, Pt.2.

March 1990: Delay Unit For Automatic Antennas; Workout Timer For Aerobics Classes; 16-Channel Mixing Desk, Pt.2; Using The UC3906 SLA Battery Charger IC; The Australian VFT Project.

April 1990: Dual Tracking ±50V Power Supply; Voice-Operated Switch (VOX) With Delayed Audio; 16-Channel Mixing Desk, Pt.3; Active CW Filter; Servicing Your Microwave Oven.

June 1990: Multi-Sector Home Burglar Alarm; Build A Low-Noise Universal Stereo Preamplifier; Load Protector For Power Supplies; Speed Alarm For Your Car.

July 1990: Digital Sine/Square Generator, Pt.1 (covers 0-500kHz); Burglar Alarm Keypad & Combination Lock; Build A Simple Electronic Die; A Low-Cost Dual Power Supply; Inside A Coal Burning Power Station.

August 1990: High Stability UHF Remote Transmitter; Universal Safety Timer For Mains Appliances (9 Minutes); Horace The Electronic Cricket; Digital Sine/Square Generator, Pt.2.

September 1990: A Low-Cost 3-Digit Counter Module; Build A Simple Shortwave Converter For The 2-Metre Band; The Bose Lifestyle Music System (Review); The Care & Feeding Of Nicad Battery Packs.

October 1990: The Dangers of PCBs; Low-Cost Siren For Burglar Alarms; Dimming Controls For The Discolight; Surfsound Simulator; DC Offset For DMMs; NE602 Converter Circuits.

November 1990: How To Connect Two TV Sets To One VCR; Build An Egg Timer; Low-Cost Model Train Controller; 1.5V To 9V DC Converter; Introduction To Digital Electronics; Build A Simple 6-Metre Amateur Band Transmitter.

December 1990: The CD Green Pen Controversy; 100W DC-DC Converter For Car Amplifiers; Wiper Pulser For Rear Windows; 4-Digit Combination Lock; 5W Power Amplifier For The 6-Metre Amateur Transmitter; Index To Volume 3.

January 1991: Fast Charger For Nicad Batteries, Pt.1; Have Fun With The Fruit Machine; Two-Tone Alarm Module; LCD Readout For The Capacitance Meter; How Quartz Crystals Work; The Dangers of Servicing Microwave Ovens.

February 1991: Synthesised Stereo AM Tuner, Pt.1; Three Low-Cost Inverters For Fluorescent Lights; Low-Cost Sinewave Oscillator; Fast Charger For Nicad Batteries, Pt.2; How To Design Amplifier Output Stages.

March 1991: Remote Controller For Garage Doors, Pt.1; Transistor Beta Tester Mk.2; A Synthesised AM Stereo Tuner, Pt.2; Multi-Purpose I/O Board For PC-Compatibles; Universal Wideband RF Preamplifier For Amateur Radio & TV.

April 1991: Steam Sound Simulator For Model Railroads; Remote Controller For Garage Doors, Pt.2; Simple 12/24V Light Chaser; Synthesised AM Stereo Tuner, Pt.3; A Practical Approach To Amplifier Design, Pt.2.

May 1991: 13.5V 25A Power Supply For Transceivers; Stereo Audio Expander; Fluorescent Light Simulator For Model Railways; How To Install Multiple TV Outlets, Pt.1.

June 1991: A Corner Reflector Antenna For UHF TV; Build A 4-Channel Lighting Desk, Pt.1; 13.5V 25A Power Supply For Transceivers, Pt.2; Active Filter For CW Reception; Tuning In To Satellite TV, Pt.1.

July 1991: Loudspeaker Protector For Stereo Amplifiers; 4-Channel Lighting Desk, Pt.2; How To Install Multiple TV Outlets, Pt.2; Tuning In To Satellite TV, Pt.2.

September 1991: Digital Altimeter For Gliders & Ultralights; Ultrasonic Switch For Mains Appliances; The Basics Of A/D & D/A Conversion; Plotting The Course Of Thunderstorms.

October 1991: Build A Talking Voltmeter For Your PC, Pt.1; SteamSound Simulator For Model Railways Mk.II; Magnetic Field Strength Meter; Digital Altimeter For Gliders, Pt.2; Military Applications Of R/C Aircraft.

November 1991: Build A Colour TV Pattern Generator, Pt.1; A Junkbox 2-Valve Receiver; Flashing Alarm Light For Cars; Digital Altimeter For Gliders, Pt.3; Build A Talking Voltmeter For Your PC, Pt.2; Build a Turnstile Antenna For Weather Satellite Reception.

December 1991: TV Transmitter For VCRs With UHF Modulators; Infrared Light Beam Relay; Colour TV Pattern Generator, Pt.2; Index To Volume 4.

January 1992: 4-Channel Guitar Mixer; Adjustable 0-45V 8A Power Supply, Pt.1; Baby Room Monitor/FM Transmitter; Experiments For Your Games Card.

March 1992: TV Transmitter For VHF VCRs; Thermostatic Switch For Car Radiator Fans; Coping With Damaged Computer Directories; Guide Valve Substitution In Vintage Radios.

April 1992: IR Remote Control For Model Railroads; Differential Input Buffer For CROs; Understanding Computer Memory; Aligning Vintage Radio Receivers, Pt.1.

May 1992: Build A Telephone Intercom; Electronic Doorbell; Battery Eliminator For Personal Players; Infrared Remote Control For Model Railroads, Pt.2; Aligning Vintage Radio Receivers, Pt.2.

June 1992: Multi-Station Headset Intercom, Pt.1; Video Switcher For Camcorders & VCRs; IR Remote Control For Model Railroads, Pt.3; 15-Watt 12-240V Inverter; A Look At Hard Disc Drives.

August 1992: Automatic SLA Battery Charger; Miniature 1.5V To 9V DC Converter; 1kW Dummy Load Box For Audio Amplifiers; Troubleshooting Vintage Radio Receivers; The MIDI Interface Explained.

October 1992: 2kW 24VDC - 240VAC Sinewave Inverter; Multi-Sector Home Burglar Alarm, Pt.2; Mini Amplifier For Personal Stereos; A Regulated Lead-Acid Battery Charger.

January 1993: Flea-Power AM Radio Transmitter; High Intensity LED Flasher For Bicycles; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.4; Speed Controller For Electric Models, Pt.3.

February 1993: Three Projects For Model Railroads; Low Fuel Indicator For Cars; Audio Level/VU Meter (LED Readout); An Electronic Cockroach; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.5.

March 1993: Solar Charger For 12V Batteries; Alarm-Triggered Security Camera; Reaction Trainer; Audio Mixer for Camcorders; A 24-Hour Sidereal Clock For Astronomers.

April 1993: Solar-Powered Electric Fence; Audio Power Meter; Three-Function Home Weather Station; 12VDC To 70VDC Converter; Digital Clock With Battery Back-Up.

May 1993: Nicad Cell Discharger; Build The Woofer Stopper; Alphanumeric LCD Demonstration Board; The Story of Aluminium.

June 1993: AM Radio Trainer, Pt.1; Remote Control For The Woofer Stopper; Digital Voltmeter For Cars; Windows-Based Logic Analyser.

July 1993: Single Chip Message Recorder; Light Beam Relay Extender; AM Radio Trainer, Pt.2; Quiz Game Adjudicator; Windows-Based Logic Analyser, Pt.2; Antenna Tuners – Why They Are Useful.

August 1993: Low-Cost Colour Video Fader; 60-LED Brake Light Array; Microprocessor-Based Sidereal Clock; Southern Cross Z80-Based Computer; A Look At Satellites & Their Orbits.

September 1993: Automatic Nicad Battery Charger/Discharger; Stereo Preamplifier With IR Remote Control, Pt.1; In-Circuit Transistor Tester; +5V to ±15V DC Converter; Remote-Controlled Cockroach.

October 1993: Courtesy Light Switch-Off Timer For Cars; Wireless Microphone For Musicians; Stereo Preamplifier With IR Remote Control, Pt.2; Electronic Engine Management, Pt.1.

November 1993: High Efficiency Inverter For Fluorescent Tubes; Stereo Preamplifier With IR Remote Control, Pt.3; Siren Sound Generator; Engine Management, Pt.2; Experiments For Games Cards.

December 1993: Remote Controller For Garage Doors; Build A LED Stroboscope; Build A 25W Audio Amplifier Module; A 1-Chip Melody

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January 1994: 3A 40V Adjustable Power Supply; Switching Regulator For Solar Panels; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994: Build A 90-Second Message Recorder; 12-240VAC 200W Inverter; 0.5W Audio Amplifier; 3A 40V Adjustable Power Supply; Engine Management, Pt.5; Airbags – How They Work.

March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Simple LED Chaser; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8; Passive Rebroadcasting For TV Signals.

June 1994: 200W/350W Mosfet Amplifier Module; A Coolant Level Alarm For Your Car; 80-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; Portable 6V SLA Battery Charger; Electronic Engine Management, Pt.10.

August 1994: High-Power Dimmer For Incandescent Lights; Microprocessor-Controlled Morse Keyer; Dual Diversity Tuner For FM Microphones, Pt.1; Nicad Zapper; Engine Management, Pt.11.

September 1994: Automatic Discharger For Nicad Battery Packs; MiniVox Voice Operated Relay; Image Intensified Night Viewer; AM Radio For Weather Beacons; Dual Diversity Tuner For FM Microphones, Pt.2; Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Build A Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Build A Temperature Controlled Soldering Station; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre DSB Amateur Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns Direct to PC Boards.

December 1994: Dolby Pro-Logic Surround Sound Decoder, Pt.1; Easy-To-Build Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 50-Watt/Channel Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

March 1995: 50 Watt Per Channel Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3; Simple CW Filter.

April 1995: FM Radio Trainer, Pt.1; Photographic Timer For Darkrooms; Balanced Microphone Preamp. & Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 8-Channel Decoder For Radio Remote Control.

May 1995: What To Do When the Battery On Your PC's Motherboard Goes Flat; Build A Guitar Headphone Amplifier; FM Radio Trainer, Pt.2; Transistor/Mosfet Tester For DMMs; A 16-Channel Decoder For Radio Remote Control; Introduction to Satellite TV.

June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; 1W Audio Amplifier Trainer; Low-Cost Video Security System; Multi-Channel Radio Control Transmitter For Models, Pt.1; Build A $30 Digital Multimeter.

July 1995: Electric Fence Controller; How To Run Two Trains On A Single Track (Incl. Lights & Sound); Setting Up A Satellite TV Ground Station; Build A Reliable Door Minder; Adding Extra RAM To Your Computer.

August 1995: Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; Audio Lab PC Controlled Test Instrument, Pt.1; Mighty-Mite Powered Loudspeaker; How To Identify IDE Hard Disc Drive Parameters.

September 1995: Keypad Combination Lock; The Incredible Vader Voice; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.1; Jacob's Ladder Display; The Audio Lab PC Controlled Test Instrument, Pt.2.

October 1995: Geiger Counter; 3-Way Bass Reflex Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Fast Charger For Nicad Batteries; Digital Speedometer & Fuel Gauge For Cars, Pt.1.

November 1995: Mixture Display For Fuel Injected Cars; CB Transverter For The 80M Amateur Band, Pt.1; PIR Movement Detector; Dolby Pro Logic Surround Sound Decoder Mk.2, Pt.1; Digital Speedometer & Fuel Gauge For Cars, Pt.2.

December 1995: Engine Immobiliser; 5-Band Equaliser; CB Transverter For The 80M Amateur Band, Pt.2; Subwoofer Controller; Dolby Pro Logic Surround Sound Decoder Mk.2, Pt.2; Knock Sensing In Cars; Index To Volume 8.

January 1996: Surround Sound Mixer & Decoder, Pt.1; Magnetic Card Reader; Build An Automatic Sprinkler Controller; IR Remote Control For The Railpower Mk.2; Recharging Nicad Batteries For Long Life.

February 1996: Three Remote Controls To Build; Woofer Stopper Mk.2; 10-Minute Kill Switch For Smoke Detectors; Basic Logic Trainer; Surround Sound Mixer & Decoder, Pt.2; Use your PC As A Reaction Timer.

March 1996: Programmable Electronic Ignition System; Zener Diode Tester For DMMs; Automatic Level Control For PA Systems; 20ms Delay For Surround Sound Decoders; Multi-Channel Radio Control Transmitter; Pt.2; Cathode Ray Oscilloscopes, Pt.1.

April 1996: Cheap Battery Refills For Mobile Telephones; 125W Power Amplifier Module; Knock Indicator For Leaded Petrol Engines; Multi-Channel Radio Control Transmitter; Pt.3; Cathode Ray Oscilloscopes, Pt.2.

May 1996: Upgrading The CPU In Your PC; Build A High Voltage Insulation Tester; Knightrider Bi-Directional LED Chaser; Simple Duplex Intercom Using Fibre Optic Cable; Cathode Ray Oscilloscopes, Pt.3.

June 1996: BassBox CAD Loudspeaker Software Reviewed; Stereo Simulator (uses delay chip); Rope Light Chaser; Low Ohms Tester For Your DMM; Automatic 10A Battery Charger.

July 1996: Installing a Dual Boot Windows System On Your PC; Build A VGA Digital Oscilloscope, Pt.1; Remote Control Extender For VCRs; 2A SLA Battery Charger; 3-Band Parametric Equaliser; Single Channel 8-bit Data Logger.

August 1996: Electronics on the Internet; Customising the Windows Desktop; Introduction to IGBTs; Electronic Starter For Fluorescent Lamps; VGA Oscilloscope, Pt.2; 350W Amplifier Module; Masthead Amplifier For TV & FM; Cathode Ray Oscilloscopes, Pt.4.

September 1996: VGA Oscilloscope, Pt.3; IR Stereo Headphone Link, Pt.1; High Quality PA Loudspeaker; 3-Band HF Amateur Radio Receiver; Feedback On Programmable Ignition (see March 1996); Cathode Ray Oscilloscopes, Pt.5.

October 1996: Send Video Signals Over Twisted Pair Cable; Power Control With A Light Dimmer; Build A 600W DC-DC Converter For Car Hifi Systems, Pt.1; IR Stereo Headphone Link, Pt.2; Build A Multi-Media Sound System, Pt.1; Multi-Channel Radio Control Transmitter, Pt.8.

November 1996: Adding A Parallel Port To Your Computer; 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; How To Repair Domestic Light Dimmers; Build A Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: CD Recorders – The Next Add-On For Your PC; Active Filter Cleans Up CW Reception; Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index To Volume 9.

January 1997: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source (For Sound Level Meter Calibration); Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1997: Cathode Ray Oscilloscopes, Pt.6; PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; Alert-A-Phone Loud Sounding Alarm; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways; Build A Jumbo LED Clock; Audible Continuity Tester; Cathode Ray Oscilloscopes, Pt.7.

April 1997: Avoiding Win95 Hassles With Motherboard Upgrades; Simple Timer With No ICs; Digital Voltmeter For Cars; Loudspeaker Protector For Stereo Amplifiers; Model Train Controller; A Look At Signal Tracing; Pt.1; Cathode Ray Oscilloscopes, Pt.8.

May 1997: Teletext Decoder For PCs; Build An NTSC-PAL Converter; Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacewriter – It Writes Messages In Thin Air; A Look At Signal Tracing; Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1997: Tuning Up Your Hard Disc Drive; PC-Controlled Thermometer/Thermostat; Colour TV Pattern Generator, Pt.1; Build An Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Control Circuit For A Stepper Motor; Fail-Safe Module For The Throttle Servo; Cathode Ray Oscilloscopes, Pt.10.

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Simple Square/Triangle Waveform Generator; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers; How Holden's Electronic Control Unit works, Pt.1.

August 1997: The Bass Barrel Subwoofer; 500 Watt Audio Power Amplifier Module; A TENs Unit For Pain Relief; Addressable PC Card For Stepper Motor Control; Remote Controlled Gates For Your Home; How Holden's Electronic Control Unit Works, Pt.2.

September 1997: Multi-Spark Capacitor Discharge Ignition; 500W Audio Power Amplifier, Pt.2; A Video Security System For Your Home; PC Card For Controlling Two Stepper Motors; HiFi On A Budget; Win95, MSDOS.SYS & The Registry.

October 1997: Build A 5-Digit Tachometer; Add Central Locking To Your Car; PC-Controlled 6-Channel Voltmeter; The Flickering Flame Stage Prop; 500W Audio Power Amplifier, Pt.3; Customising The Windows 95 Start Menu.

November 1997: Heavy Duty 10A 240VAC Motor Speed Controller; Easy-To-Use Cable & Wiring Tester; Build A Musical Doorbell; Relocating Your CD-ROM Drive; Replacing Foam Speaker Surrounds; Understanding Electric Lighting Pt.1.

December 1997: A Heart Transplant For An Aging Computer; Build A Speed Alarm For Your Car; Two-Axis Robot With Gripper; Loudness Control For Car Hifi Systems; Stepper Motor Driver With Onboard Buffer; Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Volume 10.

January 1998: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 12VAC); Command Control System For Model Railways, Pt.1; Pan Controller For CCD Cameras; Build A One Or Two-Lamp Flasher; Understanding Electric Lighting, Pt.3.

February 1998: Hot Web Sites For Surplus Bits; Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing; Command Control System For Model Railways, Pt.2; Demonstration Board For Liquid Crystal Displays; Build Your Own 4-Channel Lightshow, Pt.2; Understanding Electric Lighting, Pt.4.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Philips DVD840 Digital Video Disc Player (Review); Understanding Electric Lighting; Pt.6; Jet Engines In Model Aircraft.

May 1998: Troubleshooting Your PC, Pt.1; Build A 3-LED Logic Probe; A Detector For Metal Objects; Automatic Garage Door Opener, Pt.2; Command Control For Model Railways, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Understanding Electric Lighting, Pt.7; Universal High Energy Ignition System; The Roadies' Friend Cable Tester; Universal Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1998: Troubleshooting Your PC, Pt.3 (Installing A Modem And Sorting Out The Problems); Build A Heat Controller; 15-Watt Class-A Amplifier Module; Simple Charger For 6V & 12V SLA Batteries; Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4 (Adding Extra Memory To Your PC); Build The Opus One Loudspeaker System; Simple I/O Card With Automatic Data Logging; Build A Beat Triggered Strobe; A 15-Watt Per Channel Class-A Stereo Amplifier.

September 1998: Troubleshooting Your PC, Pt.5 (Software Problems & DOS Games); A Blocked Air-Filter Alarm; A Waa-Waa Pedal For Your Guitar; Build A Plasma Display Or Jacob's Ladder; Gear Change Indicator For Cars; Capacity Indicator For Rechargeable Batteries.

October 1998: CPU Upgrades & Overclocking; Lab Quality AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Electronic Guitar Limiter; 12V Trickle Charger For Float Conditions; Adding An External Battery Pack To Your Flashgun.

November 1998: Silicon Chip On The World Wide Web; The Christmas Star (Microprocessor-Controlled Christmas Decoration); A Turbo Timer For Cars; Build Your Own Poker Machine, Pt.1; FM Transmitter For Musicians; Lab Quality AC Millivoltmeter, Pt.2; Beyond The Basic Network (Setting Up A LAN Using TCP/IP); Understanding Electric Lighting, Pt.9; Improving AM Radio Reception, Pt.1.

December 1998: Protect Your Car With The Engine Immobiliser Mk.2; Thermocouple Adaptor For DMMs; A Regulated 12V DC Plugpack; Build Your Own Poker Machine, Pt.2; GM's Advanced Technology Vehicles; Improving AM Radio Reception, Pt.2; Mixer Module For F3B Glider Operations.

January 1999: The Y2K Bug & A Few Other Worries; High-Voltage Megohm Tester; Getting Going With BASIC Stamp; LED Bargraph Ammeter For Cars; Keypad Engine Immobiliser; Improving AM Radio Reception, Pt.3; Electric Lighting, Pt.10

February 1999: Installing A Computer Network (Network Types, Hubs, Switches & Routers); Making Front Panels For Your Projects; Low Distortion Audio Signal Generator, Pt.1; Command Control Decoder For Model Railways; Build A Digital Capacitance Meter; Remote Control Tester; Electric Lighting, Pt.11.

March 1999: Getting Started With Linux; Pt.1; Build A Digital Anemometer; 3-Channel Current Monitor With Data Logging; Simple DIY PIC Programmer; Easy-To-Build Audio Compressor; Low Distortion Audio Signal Generator, Pt.2; Electric Lighting, Pt.12.

April 1999: Getting Started With Linux; Pt.2; High-Power Electric Fence Controller; The Bass Cube Subwoofer; Programmable Thermostat/Thermometer; Build An Infrared Sentry; A Rev Limiter For Cars; Electric Lighting, Pt.13; Autopilots For Radio-Controlled Model Aircraft.

PLEASE NOTE: November 1987 to August 1988, October 1988 to March 1989, June 1989, August 1989, December 1989, May 1990, August 1991, February 1992, July 1992, September 1992, November 1992, December 1992 and March 1998 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.00 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disc for $10 including p&p, or can be downloaded free from our web site: www.siliconchip.com.au

Getting started with Linux; Pt.3

This month we'll show you how to put Linux to work. In particular, we'll look at configuring Linux as a file and printer server to a Windows network and describe how to use Linux as a router, so that several people can share an Internet connection.

By BOB DYBALL

For many people, the word "LAN" or even "computer" evokes fear and trepidation at the expenses that will be incurred. Fortunately, Linux can provide a low-cost solution to many networking requirements, especially when it comes to shared Internet access.

As we learnt last month, by running Linux, there's still some life that can be squeezed out of many old 486s and slower Pentium machines. For example, if you have 2, 3, 10 or even 20 people who would like Internet access (eg, for email), a humble 486 running Linux and a single Internet feed are about all you need to get going.

Be warned though that Linux isn't for everyone and takes some time to learn. If you really need to keep your existing system running (eg, in a production or office environment), don't go messing with things too much. Instead, set up a small test network and work up to the grand plan slowly.

Also, because of the differences between one version of Linux and another (eg., kernel 2.03.6 to 2.2.1) and between the different "distributions" (eg, Red Hat versus Caldera), it will be necessary to generalise here on occasions. Fortunately, most of the differences are quite minor, some simply involving a different installation directory or different standard settings,

The worst case scenario for a new Linux user might be the need to recompile the kernel – something that wouldn't be too much fun early on unless you're the adventurous type.

OK, let's take a look at how to set up a Linux installation to function as a file and printer server.

The wrong and the right way to share printers

The moment you have less printers than PCs, you'll run into a familiar problem – how do you allow those people without printers to print documents without interrupting those with printers. Faced with this problem, some people don't even consider a LAN or if they do, think that a printer switch box is the cheaper way to go.

If you've just bought a printer switch box, you probably won't like reading this. But think about it – if you allow $40 or so for the switch box and then add the cost of the cables to connect

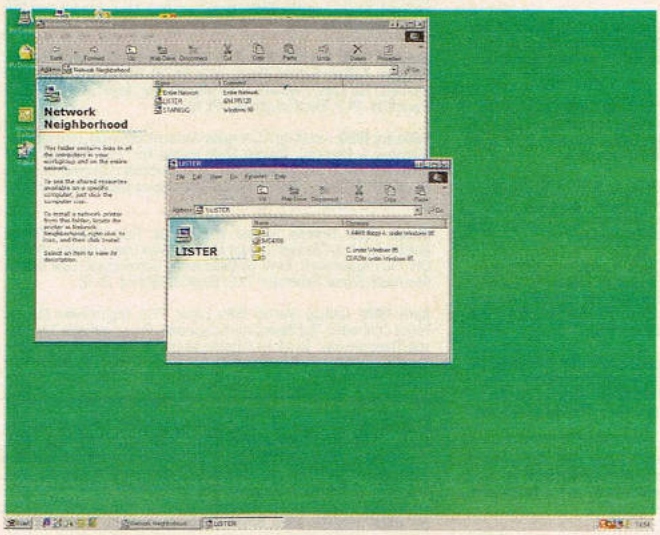


Fig.1: this screen shot is from a Windows 98 system, looking across a network at shared resources on a Windows 95 machine named "Lister".

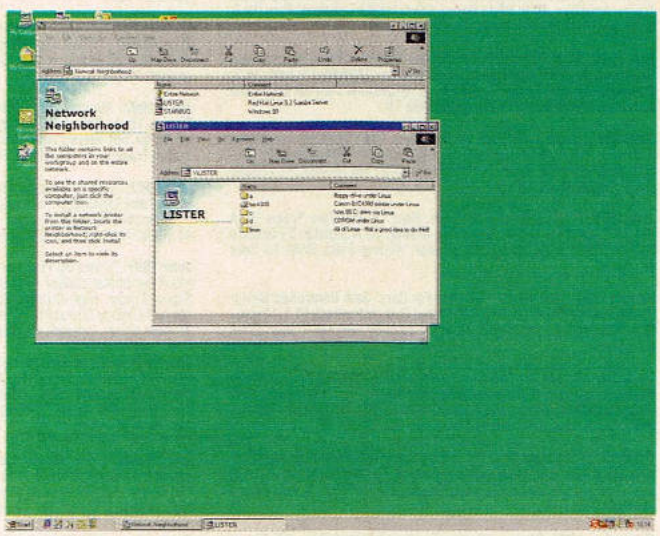


Fig.2: this screen shot is from the same Windows 98 system. It's looking at the same machine as before but now running Linux, with file and printer sharing courtesy of Samba.

the PCs, you're not going to get much change from $100. In fact, depending on the number of PCs you have, it could cost you a lot more.

Another drawback is that printer cables are limited in length to a couple of metres, unless you buy special (and expensive) long cables or a line buffer. After that, cable capacitance can cause signal degradation and reliability problems. What's more, a manual printer switch is a real source of frustration. It's all too easy to forget about the switch, which means that your job often won't print because the wrong computer or printer is selected.

There is a better, easier and cheaper way of doing things – network the computers. All you need for a two-PC LAN are a couple of cheap network cards at $25-$40 each, a length of coaxial cable, two T-pieces and a couple of 50Ω terminators. Make sure you use 50Ω cable, because leftover 75Ω TV coax won't work. Also, it's a good idea to buy "combo" network cards, which have connectors for both 10Base-2 (coax) and 10Base-T cable.

By including the 10Base-T option, you can easily expand the network later on by adding a hub and changing over to Cat.5 cable – without the added cost of new network cards. Of course, a hub will add to the cost but a 10Base-T (star) network is more reliable than a 10Base-2 network once you have three or more PCs. A cable break only affects one computer on a 10-Base-T network, while all computers on a 10Base-2 network are affected.

For a simple two or three-PC network though, coaxial cable is the cheapest way to go and reliability won't be a problem. Depending on the cards you buy, you can network three PCs for less than $120-$150.

Once you have a network up and running, you can easily share resources such as printers and CD-ROM drives without any hassles. And you can easily transfer files between computers and that's something you can't do via a printer switch box.

Why a dedicated server?

To avoid disrupting others on a network, you need to set up a dedicated server. Often, this needn't be anything more than an old 486 with 8MB of RAM. This type of machine would run rather slowly under Windows 95 but would give quite good performance running Linux and "Samba".

Fig.3: The Samba Configuration File

```
# The main Samba configuration file - for sharing within a Workgroup
#======================= Global Settings =====================================
[global]

# workgroup = NT-Domain-Name or Workgroup-Name
  workgroup = WORKGROUP

# server string is the equivalent of the NT Description field
  server string = Red Hat Linux 5.2 Samba Server

# This option is important for security. It allows you to restrict
# connections to machines which are on your local network. The
# following example restricts access to two C class networks and
# the "loopback" interface. For more examples of the syntax see

# the smb.conf man page
  hosts allow = 192.168.1. 127.
# if you want to automatically load your printer list rather
# than setting them up individually then you'll need this
  printcap name = /etc/printcap
  load printers = yes

# this tells Samba to use a separate log file for each machine
# that connects
  log file = /var/log/samba/log.%m

# Put a capping on the size of the log files (in Kb).
  max log size = 50

# Security mode. Most people will want user level security. See
# security_level.txt for details.
  security = user

# Most people will find that this option gives better performance.
# See speed.txt and the manual pages for details
  socket options = TCP_NODELAY

# Cause this host to announce itself to local subnets here
  remote announce = 192.168.1.255

# Browser Control Options:
# set local master to no if you don't want Samba to become a master
# browser on your network. Otherwise the normal election rules apply
  local master = no

# OS Level determines the precedence of this server in master browser
# elections. The default value should be reasonable
  os level = 33

# DNS Proxy - tells Samba whether or not to try to resolve NetBIOS names
  dns proxy = no

#============================ Share Definitions ==============================
[a]
  comment = floppy drive under Linux
  path = /mnt/floppy
  public = yes
  writable = yes
  printable = no

[c]
  comment = Win 95 C: drive via Linux
  path = /fatc
  public = yes
  writable = yes
  printable = no

[d]
  comment = CDROM under Linux
  path = /mnt/cdrom
  public = yes
  writable = no
  printable = no

[linux]
  comment = All of Linux - Not a good idea to do this!!
  path = /
  public = yes
  writable = yes
  printable = no

[bjc4300]
  comment = Canon BJC4300 printer under Linux
  public = yes
  writable = no
  printable = yes
```

Fig.4: Alternative Samba Configuration File

```
# The main Samba configuration file - for sharing within an NT-Domain
#======================= Global Settings ===================================
[global]
# workgroup = NT-Domain-Name or Workgroup-Name
  workgroup = REDDWARF
# server string is the equivalent of the NT Description field
  server string = Red Hat Linux 5.2 Samba Server
# This option is important for security. It allows you to restrict
# connections to machines which are on your local network. The
# following example restricts access to two C class networks and
# the "loopback" interface. For more examples of the syntax see
# the smb.conf man page
  hosts allow = 192.168.1. 127.
# this tells Samba to use a separate log file for each machine
# that connects
  log file = /var/log/samba/log.%m
# Put a capping on the size of the log files (in Kb).
  max log size = 50
# Security mode. Most people will want user level security. See
# security_level.txt for details.
  security = server
# Use password server option only with security = server
  password server = REDDWARF
# Most people will find that this option gives better performance.
# See speed.txt and the manual pages for details
  socket options = TCP_NODELAY
# Cause this host to announce itself to local subnets here
  remote announce = 192.168.1.255
# Browser Control Options:
# set local master to no if you don't want Samba to become a master
# browser on your network. Otherwise the normal election rules apply
  local master = yes
# OS Level determines the precedence of this server in master browser
# elections. The default value should be reasonable
  os level = 33
# Domain Master specifies Samba to be the Domain Master Browser. This
# allows Samba to collate browse lists between subnets. Don't use this
# if you already have a Windows NT domain controller doing this job
  domain master = yes
# Preferred Master causes Samba to force a local browser election on startup
# and gives it a slightly higher chance of winning the election
  preferred master = yes
# Enable this if you want Samba to be a domain logon server for
# Windows95 workstations.
  domain logons = yes
# Where to store roving profiles (only for Win95 and WinNT)
#    %L substitutes for this servers netbios name, %U is username
#    You must uncomment the [Profiles] share below
  logon path = \\%L\Profiles\%U
# DNS Proxy - tells Samba whether or not to try to resolve NetBIOS names
# via DNS nslookups. The built-in default for versions 1.9.17 is yes,
# this has been changed in version 1.9.18 to no.
  dns proxy = no
#============================ Share Definitions ==============================
... etc
```

With a little more work, a modest Linux PC could also be used to validate users on a network, all for a fraction of the cost of a Windows NT system – both in terms of software and hardware.

For those familiar with workgroups as opposed to "domains" on a network, a Windows NT server can hold usernames and passwords. This allows you to centrally control access to file shares, printers and other devices.

Another advantage of this scheme is that users need not worry about using the same PC from day to day, as their "profiles" (or settings) can travel with them as they log onto other PCs on the network. The log-on process under Linux with Samba (or Windows NT) saves you from having to set passwords right across a peer-to-peer network, which is very useful if more than a few people use the system.

Samba has become a popular addition to most Linux distributions and is usually available as an option that can be installed with the rest of Linux. Both the popular Red Hat 5.2 and Caldera Open Linux 1.3 packages have Samba added to their installation programs.

If you haven't installed Samba or if your version of Linux doesn't provide this, Samba is available as a compressed archive for download, or as an RPM file. RPM stands for "Red Hat Package Manager", a handy format that packages the file and installation instructions to Linux.

Samba has another part to it called "Samba Client", which works in reverse. If there is a file share or printer share on a Windows network, then Samba Client can provide access to these from a Linux workstation.

Setting up Samba

Fig.3 shows the Samba configuration file (smb.conf) which is found in the /etc directory. From this, you should have no trouble when it comes to setting up share definitions.

This much-simplified file is based on the standard Samba smb.conf file and is not designed with high security in mind. It's probably best to start with a simple smb.conf file like this and work from there, as there are many options. Note that the original sample smb.conf file includes comments to show you where to add in username/password access.

If you want to have your Linux/Samba server "look" more like a Windows NT server and use "Domain" logons instead, then you might change your smb.conf file to something more like Fig.4.

At the same time, you'll need to make a couple of changes to the configuration of your Windows 95/98 computers. These changes are both made using the Network applet found in Control Panel. Double-click the Network icon, then click Client for Microsoft Networks, then click Properties. For workgroup or "peer to peer" networking, make sure that the "Log onto Windows NT domain" option is unchecked – see Fig.5.

Now click OK, then click the tab marked "Access Control". For workgroup networking, you would normally select "Share-level access control" (see Fig.6), relying on each printer or file share across the network to have its own individual security though passwords, or not as the case may be.

Alternatively, if using a domain log on, a single password log on to the Linux server (in the guise of a Windows NT domain server, again courtesy of Samba) will verify your access to file or printer shares across the network. With this system, there is only one password to remember, not one for every different machine across the network that has a resource you might wish to use.

A Windows 95/98 PC set for do-

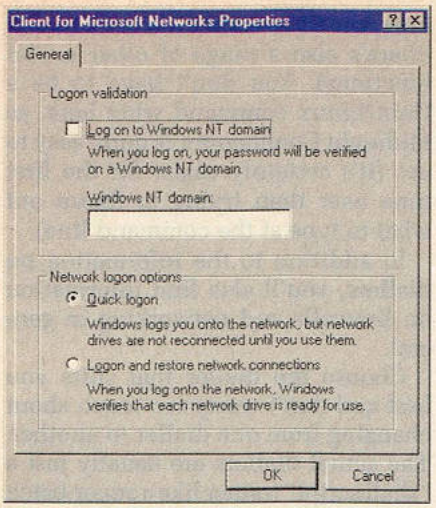

Client for Microsoft Networks Properties
General
Logon validation
Log on to Windows NT domain
When you log on, your password will be verified on a Windows NT domain.
Windows NT domain:
Network logon options
Quick logon
Windows logs you onto the network, but network drives are not reconnected until you use them.
Logon and restore network connections
When you log onto the network, Windows verifies that each network drive is ready for use.
OK
Cancel

Fig.5: for workgroup or "peer to peer" networking, make sure that the "Log onto Windows NT domain" option is unchecked.

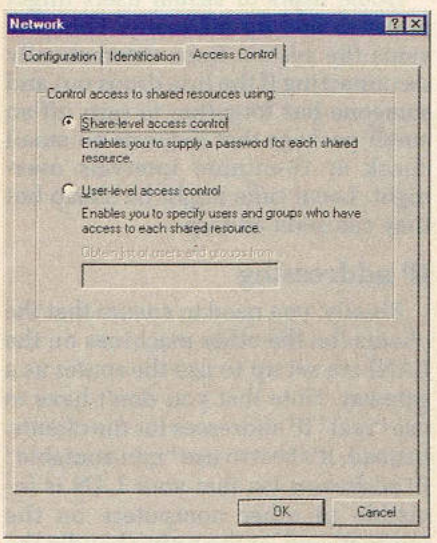


Fig.6: for workgroup networking, you would normally select "Share-level access control", relying on each printer or file share across the network to have its own individual security though passwords.

main log ons and user level access is set up as shown in Fig.7 and Fig.8. In this case, check the box "Log onto Windows NT domain" and enter in the domain name of the server you wish to log on to. Click OK, then click "User-level access control" and again enter the domain name.

On large networks, one normally finds a Windows NT server set up as a "Primary Domain Controller" (or PDC). Such networks also usually include one or more NT machines running as backups. These are called, funnily enough, "Backup Domain Controllers" or BDCs and take over if the PDC fails. A similar arrangement could also be set up using Linux servers running Samba, although that is beyond the scope of this article.

So in summary, rather than have dozens of different passwords across a network, or none at all because it's too cumbersome, consider running Samba in its domain setup rather than as a simple workgroup system.

If you've only a few users to set up, you might do this manually using *adduser*. Note that Red Hat Linux has a slightly different *adduser* utility compared to other distributions, so check its use by using the command *man adduser*. Although it's possible to edit the name/password file, it's not good practice since file locks are placed on the file (*/etc/passwd*) during editing that might prevent others logging on. Note that passwords are visible in the */etc/passwd* file but are encrypted.

Another useful command is *passwd*, used to set a particular user's password. Again, typing *man passwd* will give more information on this command.

For more information on users and administration in general, either check the FAQ area of the website covering your distribution or see the Linux Documentation Project at *sunsite.unc.edu* in the */pub/Linux/docs/LDP* directory.

Setting up Linux as an Internet gateway or "router"

Another common network problem is where multiple users require Internet access but you only have one phone line available. So how do you go about solving this problem without installing extra phone lines and buying extra modems? A router is the answer and no, it need not break the bank.

By installing a router, individuals on the network can access the Internet via a single modem attached to one computer – in this case, your Linux server. In fact, a router will even allow multiple users to access the Internet (all using the same ISP account) at the same time via this single connection, although things can get rather slow if more than a few people are logged on.

By installing a router package, an old 486 running Linux can easily serve up to 10 or 20 people. Obviously, if everyone is a heavy user of the net, you need to provide the router with a decent Internet feed to keep things running smoothly. A household or a small business can usually get away with sharing one modem between several people (since not everyone's going to be browsing at the same time), while a large business might need a 64k or 128k ISDN feed.

In simple terms, you can think of a router as behaving like a mail sorter and postman. Incoming and outgoing envelopes, known as "packets" on the LAN, are "routed" to their correct destinations, depending on where they're coming from and where they're meant to go.

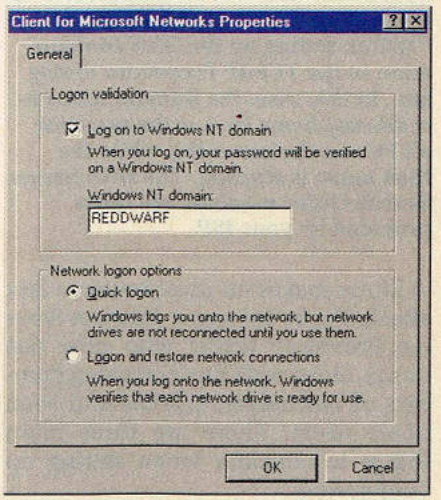

Client for Microsoft Networks Properties
General
Logon validation
Log on to Windows NT domain
When you log on, your password will be verified on a Windows NT domain.
Windows NT domain:
REDDWARF
Network logon options
Quick logon
Windows logs you onto the network, but network drives are not reconnected until you use them.
Logon and restore network connections
When you log onto the network, Windows verifies that each network drive is ready for use.
OK
Cancel

Fig.7: here's how to set up a Windows 95/98 PC for domain name log ons. Use the same domain name for all PCs on the network.

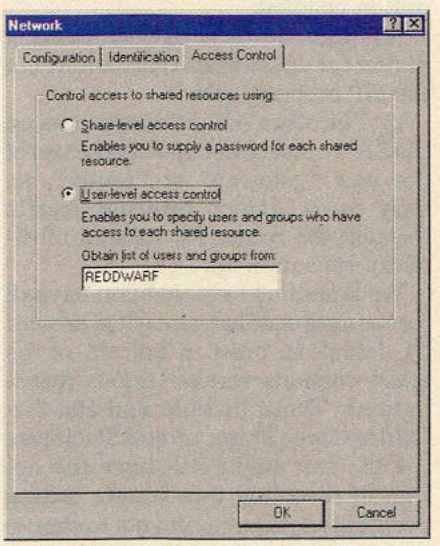


Fig.8: after setting up the domain name (see Fig.7), click the Access Control tab, click "User-level access control" and again enter the domain name.

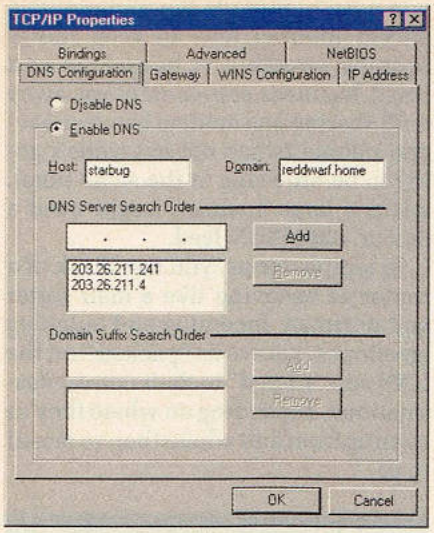


Fig.9(a): setting up the DNS configuration in the TCP/IP Properties dialog box. In this case, the Domain name is *reddwarf.home* (this is the same for all PCs on the network), while the Host name is *starbug*. The DNS Server Search Order numbers are those provided by your ISP.

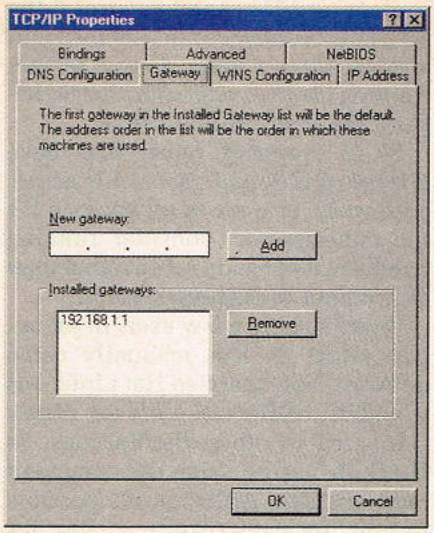


Fig.9(b): after setting the DNS Configuration, click the Gateway tab and enter in the IP address for the Gateway/Router machine (ie, the Linux machine) in the window below "New gateway" and click Add. The address will then be shown in the "Installed gateways" window.

Linux makes an ideal router, a fact attested to by the many Internet Service Providers (ISPs) who now use Linux, along with the increasing numbers of businesses, schools and even home users. There are three main things to consider when setting up your system:

(1) Linux must have its Kernel set up for IP forwarding (some distributions do not have this as standard and will have to be recompiled with this option enabled;

(2) Linux needs to have an Internet dialler set up, so that it can connect to the ISP account; and

(3) The other "client" computers on the LAN must be set up to make use of the new "gateway" or "router"; ie, they must direct Internet traffic through the router PC instead of directly via a modem.

We'll assume here that you have IP forwarding enabled, since it is present by default in most, if not all, of the latest versions across various distributions. These include Red Hat 5.2, Caldera Open Linux 1.3 and Slackware 2.0.36. You might still have the option of disabling this feature during installation, so be careful not to choose the wrong options.

When it comes to an Internet dialler for Linux, there are lots of choices. You'll find there are diallers that provide only SLIP, while other diallers provide PPP. On your Linux distribution CD-ROM, you should find a useful guide to PPP access under /doc/FAQ/html/PPP-FAQ.html. If you don't have a browser up and running, refer to the text version at /doc/FAQ/txt/PPP-FAQ instead.

As with the Windows 95/98 diallers, some Linux diallers have what's known as "dial on demand". This means that they automatically dial your ISP when ever a program function requires an Internet connection (eg, when checking for email). After a given period of inactivity, these will hang up the line automatically.

If you are fortunate enough to have a permanent connection, the system should be set up to automatically redial if the line drops out for some reason (this is done to maintain the connection). For more information on dial on demand (diald), including examples, check the "how to" files on the distribution CD-ROM. These are usually found in /doc/HOWTO/mini/diald (note: under Linux this, like most things, is case sensitive).

If you want a quick and simple way to view these files, do the following:

- type *mount /mnt/cdrom* to allow access to the CD (*umount /mnt/cdrom* releases it).
- type *mc* to run Midnight Commander, for easy access to Linux.

Once Midnight Commander is running, use F3 to view a file or F4 to edit (there's also a range of other useful functions). You don't have to be a Unix/Linux command whiz here, as Midnight Commander is quite easy to use (it's certainly easier for the first time user than trying to figure out what to type at the command line).

In addition to the information on diallers, you'll also find information on firewalls and networking in general.

Choose the dialler that suits you best and don't worry too much about changing from one dialler to another. The actual diallers are usually just a "shell script" (rather like a super-batch file, for those used to DOS). Simple or even quite complex tasks that might otherwise be repetitive can easily be automated using "shell scripts".

Home users or casual users might prefer to dial up manually. This prevents the system from automatically reconnecting if the line drops out and someone has forgotten to turn off an email package that requests an email check at 10-minute intervals overnight. Local calls might be cheap but they can soon add up.

IP addressing

Finally, you need to ensure that the clients (ie, the other machines on the LAN) are set up to use the router as a gateway. Note that you don't have to use "real" IP addresses for the clients. Instead, it's best to use "non-routable" IP addresses (so that your LAN is invisible to other computers on the Internet) and let the router handle the rest.

If you have a permanent connection, your ISP will usually assign you one IP address and this is given to the router. Alternatively, for dial up connections, the IP address is assigned automatically to the dialler, so you don't have to bother about it.

We talked about IP addressing in "Beyond the Basic Network – Setting up a LAN using TCP/IP" (see SILICON CHIP, November 1998). In particular, we mentioned that the Internet Assigned Numbers Authority (IANA) has reserved the following three blocks of non-routable IP addresses for "private Internets" (ie, Intranets). These address blocks are as follows:

10.0.0.0	to	10.255.255.255
172.16.0.0	to	172.31.255.255
192.168.0.0	to	192.168.255.255

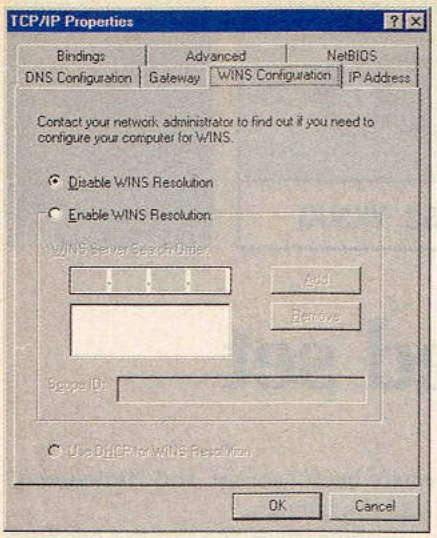


Fig.10(a): in most cases, you will have to select "Disable WINS Resolution" in this dialog box, as WINS (Windows Internet Naming Service) is generally only used on large networks. For small networks, you can use lmhosts.

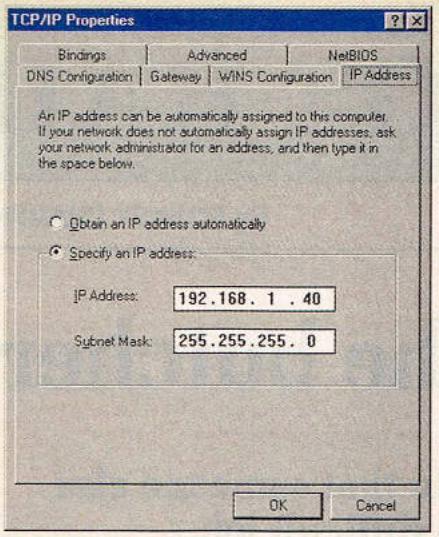


Fig.10(b): next, click the IP Address tab, check "Specify IP Address" and enter in the IP address for that computer (192.168.1.40 in this case), along with the Subnet Mask (use 255.255.255.0 for all machines).

For this and further details on IP addressing, point your web browser to http://ucnet.canberra.edu.au/RFC/rfc/rfc1918.html

The IP address 127.0.0.1 is a special address that's refers to some other program on the PC itself – in this case, the router.

What you have to do now is assign an IP address for each of the machines on the network. For example, let's use 192.168.1.1 for the Linux machine with the gateway/router, 192.168.1.40 for the first client computer on the network, 192.168.1.80 for a second client, and so on.

Don't use 192.168.1.255 or similar .255 addresses, and don't use .0 addresses, as they have a special meaning in a network like this.

You also have to enter in a Domain name and a Host name on each PC and you do that via the DNS Configuration tab of the TCP/IP Properties dialog box as shown in Fig.9(a). In this case, the Domain name is *reddwarf.home* (this is the same for all PCs on the network), while the Host name is *starbug* (a different Host name is used for each PC).

This done, click the Gateway tab, enter in the IP address for the Gateway/Router machine (at New gateway) and click Add (Fig.9(b)). You also select Disable WINS Resolution (see Fig.10(a)), after which you click the IP Address tab and enter in the IP address for that computer (192.168.1.40), along with the Subnet Mask (use 255.255.255.0 in all cases) – see Fig.10(b).

On the client computers, you would normally set the Primary and Secondary DNS to the addresses given to you by your ISP. Leave the gateway IP address blank on the gateway/router itself (since it is one) and configure the DNS settings on the router to reflect those your ISP would tell you to use if you were running a single Windows 95/98 dial up.

Fig.11: Example *LMHOSTS* File

```
#IP Address        Machine name
#
192.168.1.1        lister
192.168.1.40       starbug
192.168.1.80       holly
```

Fig.12: Example Linux *hosts* File

```
127.0.0.1        localhost.localdomain    localhost
192.168.1.1      lister.reddwarf.home     lister
192.168.1.40     starbug.reddwarf.home    starbug
192.168.1.80     holly.reddwarf.home      holly
```

Lmhosts

In order for the machines to "find" each other on the network, you now need to create a simple text file called *LMHOSTS* (ie, no extension) and copy it to the C:\WINDOWS directory of each Windows 95/98 machine. This lists the IP address of each machine on the network and its (Host) name.

Fig.11 shows the *LMHOSTS* file you would use for the example given above (the lines starting with "#" are comments and don't do anything). Note that a reboot is necessary after adding (or altering) an *LMHOSTS* file.

You also need to add a similar file to the /etc directory of your Linux machine. In this case, the file is called *hosts* (not *LMHOSTS*) and you must list the IP address, the Domain name and the Host name of each computer – see Fig.12. You must also include the IP address for the localhost (this isn't necessary for Windows 95/98/NT as localhost is automatically defined as 127.0.0.1).

You may be wondering about the Domain name ending in *.home* rather than *.com* or *.com.au*. Well, you can use almost anything you like here since it only has to be recognised by your local network.

What's more, using the *.home* extension means that your private domain cannot be "seen" by the Internet, just as the Internet cannot access the non-routable IP addresses listed above. Should any reference to these domain names or IP addresses appear out in the outside world on the Internet, they would be ignored.

If you have more than about 20 computers, editing all the *LMHOSTS* files becomes a nuisance when you want to add extra machines to the network. There are a few shortcuts but when you reach that stage, it's best to consider using either WINS (Windows Internet Naming Service), DHCP (Dynamic Host Configuration Protocol), or a DNS (Domain Naming System).

In Pt.4, we'll talk about Linux firewalls and security issues. We also plan to discuss what DNS, WINS, DHCP and hosts or LMHOSTS actually do (probably in a separate article). And so that Windows users do not feel unloved, we'll describe how these relate to Windows 95, Windows 98 and Windows NT as well. **SC**

VINTAGE RADIO

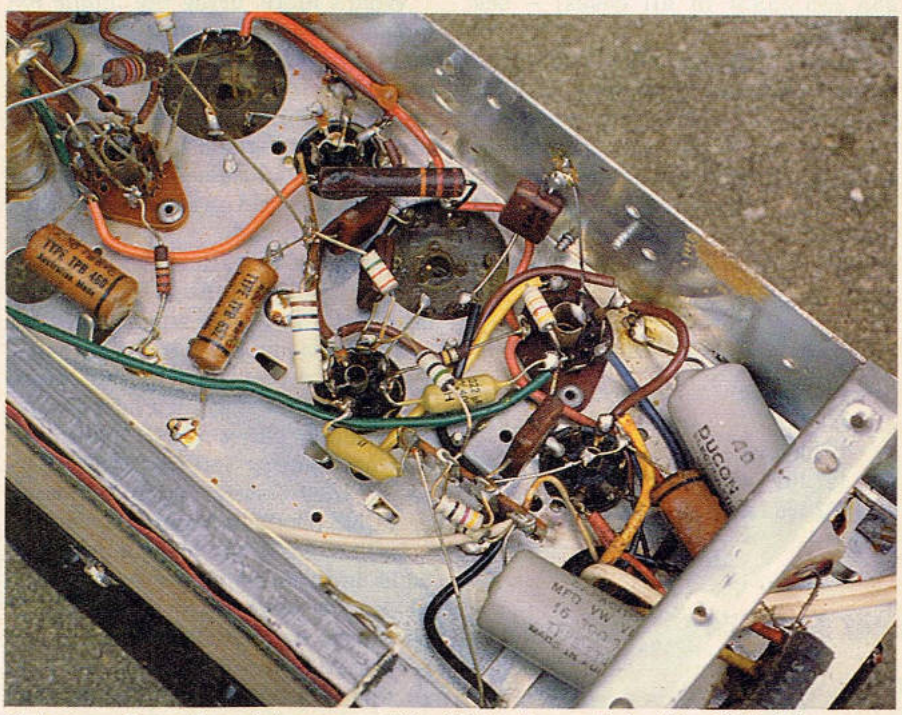
By RODNEY CHAMPNESS, VK3UG

Restoring the butchered set

Restoring a vintage radio that someone else has had a go at can be a difficult job. Sometimes the fault will be quite subtle but all too often, the previous restorer will have made a complete mess of things.

It's not unusual to come across a set that has been really butchered. When you see such a set, it makes you think that the person who did the work on it should be granted the striped apron award and then hung, drawn and quartered.

Often, these sets are obtained for what appears to be a reasonable price and the seller often says that there isn't much wrong with the radio. Sometimes however, the seller has tried to get the set going but has finished up with a mess that's bigger than when the work was started. This is a case where a little knowledge can be dangerous. Caution is needed in restoring sets that haven't been "got at" and an enormous amount of caution is needed where as set has obviously been "got at" and "butchered" into the bargain.



This view shows the wiring around the 6M5 valve socket of the Little Nipper radio that I was given to service. Before removing any parts, it's a good idea to make a drawing of the connections so that it can be easily reassembled later on.

In some cases, the restorer has been very careful with the work but has been unsuccessful because they didn't understand how the circuit worked. In other cases, everything has been done correctly and the lack of success is due to a faulty new part. Yes, that happens occasionally and people with considerable experience get caught as well.

A snap diagnosis

When I built my first radio in 1954 (a "Marconi" 1-valve kit), I couldn't get it to work. I then took the typical but totally useless approach of a novice and pulled it to pieces and rebuilt it – more than once, actually – and it still didn't go! It must be the 3V4 valve, I reckoned, so I sent it back to the supplier and they sent me another one and the set then worked.

For once, the diagnosis of "it must be the valve" was correct but it often isn't. I had no test gear, virtually no radio knowledge and no hope of finding out what was wrong. My so-called diagnosis was nothing more than a lucky guess.

Of course, once the set was operating, I became the local radio expert – at least, in my opinion. I was soon brought back to earth. A cousin and I tried to get his 1-valve (1D8GT) radio going a little later on and we had no success with it at all. Like mine, I wondered some years later if we had inadvertently put HT voltage on the filament of the valves! We'll never know.

In circumstances like this, it is better to get some advice from a restorer more experienced than you are. When we lack the experience of years in the trade, it's easy to overlook things that

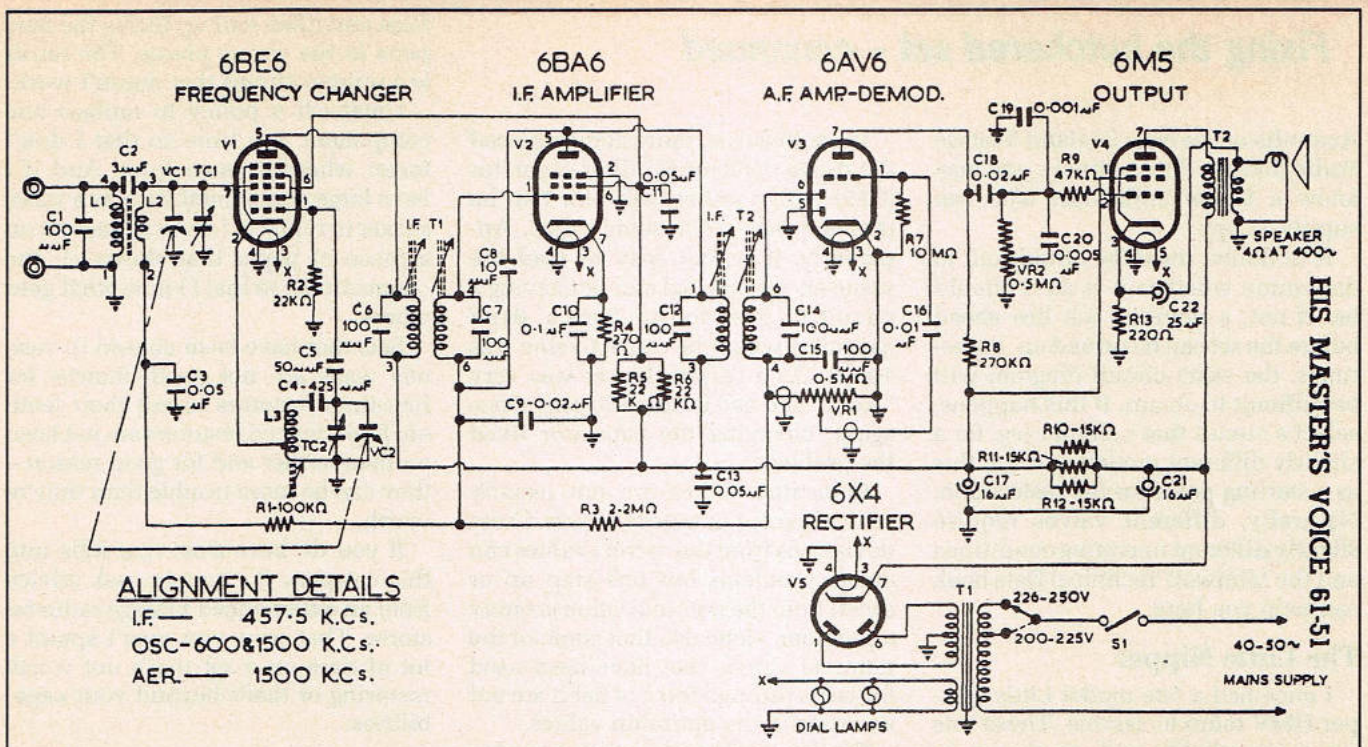


Fig.1: the circuit of a late-model HMV "Little Nipper". Substituting incorrect component values can really upset the performance of a circuit like this.

a more knowledgeable person would detect quickly.

For example, I got bogged down trying to get my VHF amateur radio station going on the 144-148MHz band soon after I got my licence. I literally didn't have a clue and so a friend and I bundled all our amateur radio gear into the car and travelled 100km to the nearest VHF amateur radio operator. He helped both of us get the equipment going, explained to us what he was doing and encouraged us in various ways.

We never looked back from that time onwards. And so it is with new restorers. A little help at the right time and you'll really start to have a satisfying time restoring your radio gems.

The things people do

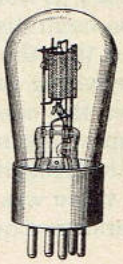
What people manage to do to the sets they are restoring could fill a book. My first story concerns a friend's brother-in-law. He acquired a 6V vibrator mantle set which he asked my friend about and was told that it was a battery operated set. Obviously, this advice didn't sink into the "smart-alec" brother-in-law's head, as he promptly removed the 50A battery clips and substituted a 3-pin mains plug. He then plugged the set into the 240V mains supply.

There are no prizes for guessing what happened next. All the valves now have no filaments, while the fate of the vibrator is unknown As for the rest of the set, heaven knows what damage has been done. A perfectly good set was instantly turned into junk and it's now a very doubtful proposition for restoration.

This same scenario often occurs when 32V sets are bought or sold to the local secondhand/antiques shop. Unfortunately, 32V sets look like their 240V AC cousins and usually have 3-pin plugs on their power cords. Plugged into 240V, things light up brilliantly for a fraction of a second until the fuses in the set blow – that is, if they haven't been replaced with a 2-inch nail (the original 300A slow-blow fuse). Remarkably, many 32V sets survive such harsh treatment but be aware that all may not be well in such a set.

Then there are the sets that someone has actually got into and "serviced". These are the real worry and before even switching them on, it's advisable to obtain a circuit diagram from the Historical Radio Society of

Looking for an old valve?



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Australia or the New Zealand Vintage Radio Society. Alternatively, you may know a fellow enthusiast who can supply a copy.

If in doubt, trace the circuit out to determine whether it is as it should be. If not, a rewiring job lies ahead before the set can be turned on. Sometimes, the exact circuit diagram will be difficult to obtain. If this happens, select a circuit that's similar (eg, for a slightly different model) and use this as a starting point for the restoration. Naturally, different valves require slightly different operating conditions and the Miniwatt Technical Data book can help you here.

The Little Nipper

I once had a late model Little Nipper HMV radio to service. These sets are quite reliable and, as shown in Fig.1, the circuit is quite straightforward. This particular set suffered from instability in the IF amplifier.

In this circuit, the AGC bypass/filter capacitor (C9) not only filters the AGC line but also acts as part of a neutralising circuit with C8 (this just goes to show that pentodes, as well as triodes, can benefit from neutralising in RF circuits). I found that the restorer had installed the wrong value for C9 (about 10 times the correct value). This in turn upset the neutralisation and caused the instability. As soon as the correct value was installed for C9, the set performed quite nicely.

In another case, the restorer replaced the diode detector RF filter capacitor (C15) with another capacitor that he thought was of the same value. Apparently, it wasn't easy to read the value on the original and not having a circuit to refer to, he used a .01µF capacitor when the correct value was 100pF. As a result, the set was very "bassy" and had little audio gain. Once again, changing the capacitor fixed the problem.

Capacitor values are not usually critical except in tuned circuits. Gross deviations from the correct values can create problems but one step up or down from the nominal value is rarely a problem. Note also that some of the nominal values that have been used for years through force of habit are not necessarily the optimum values.

On the other hand, resistors tend to be more critical and so the correct values should be used in that part of that particular set's circuit. By following the general component values, as shown in Fig.1, the performance should be quite reasonable.

The worst sets

The worst sets to get back into operation are those where the restorer has decided to replace things "willy-nilly", in an effort to get the set going. In some cases, all the paper capacitors are taken out and then a new batch is put back in.

Unfortunately, many people forget to draw diagrams of where things come from and often end up fitting the new parts in the wrong places. The result is a unique circuit that doesn't work.

I make it a policy to replace one component at a time so that I don't forget where it came from. And if I have large component such as a valve socket to replace, I draw a diagram on a piece of paper that shows all the connections, so that I know what goes where.

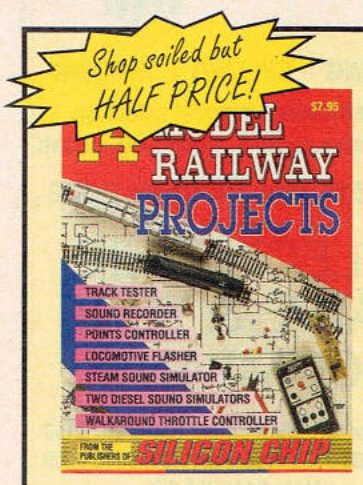
Sets that have been abused in various ways are not good choices for first-time restorers to cut their teeth on. Experienced restorers are not keen on them either and for good reason – they can be more trouble than they're worth.

If you do have a set that falls into this category it's best to seek advice from an experienced vintage radio restorer. That way, you won't spend a lot of time on a set that's not worth restoring or that's beyond your capabilities.

Manufacturing faults

Finally, note that some sets had faults built into them right from when they were manufactured. If you can detect the errors made (and they may not be easy to find), you may well be able to say "it goes better than new". I've encountered a few stinkers like that over the years and they generally become first class sets once the problems have been ironed out. Of course, the faults are usually very subtle and take some hunting down.

That said, restoring a vintage radio set that someone else has given up on is a very satisfying experience. Have fun. SC



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Class A amplifier in monoblock form

Could you please outline the modifications which would be necessary to run the Class-A amplifier as two monoblocks, each using their own dedicated power supply? To keep the convenience of one volume control, I would retain the separate amplifier and power-supply box design shown in your article.

However, I would love to see you publish a control unit worthy of this amplifier! In such an event, would the monoblock setup enable each module to be housed in the same casing as its respective power supply, (ie, two self-contained units) or would it be best kept as is?

In addition, I have two 20-0-20V 160VA toroidal transformers which I intend to use. Will I need to add some windings to the secondaries, or would the slightly lower voltage not be significant? Just following on from that, I was thinking of building a pair of horn speakers and was wondering how the Class-A amplifier would play at the extremely low power levels (milliwatts) that horns require (due to their highly efficient nature).

Many horn buffs recommend using low power Class-A triode amplifiers, claiming that some transistor amplifiers sound bad through horns, as they have difficulty playing cleanly at very low levels. Their reasoning is that the transistors perform best while driving the high currents they are designed for, rather than at a level which they describe as being "barely turned on/hardly working".

Would the use of the high power Motorola MJL21193/4s suffer the problem described above? Or would this be the case with any transistor amplifier (Class-A or otherwise)? In addition, would the distortion levels at such a low power level increase to the point of becoming intrusive? (P. S., Mt Colah, NSW).

● No component changes should be necessary to run class-A monoblocks although you will need two separate power supplies, as you have noted. Make sure that the volume control wiring is well shielded so that it does not pick up any hum from the power supply. We are giving serious thought to a control unit although it is far too early to say when a design might appear.

The Class-A amplifier will perform superbly at low levels, simply due to the fact that it is class-A. As you can read in the article, we estimate that low level distortion is probably less than .0002%. This is vastly less than the typical distortion in a horn loudspeaker. The real merit of a horn loudspeaker is its efficiency not high fidelity. Triode amplifiers are generally low-fi designs. For best quality from a valve design you need to use an ultra-linear push-pull design and even that will not go anywhere near the quality of our Class-A design.

Trigger problem in multi-spark CDI

While building the Multi-Spark CDI described in the September 1997 issue, I came across the following faults: (1) if both points circuits are fitted to the board but only one is used, the circuit will not fire because the other points circuit will hold the input of Q4 high via diode D12 or D13; (2) in the circuit shown to trigger a standard tacho (page 30), Q1 should be a BC327 PNP transistor, not a BC337 as shown.

Although I have the tacho circuit firing, it will not move the tacho at all. Can you offer any suggestions? Would a resistor in series with the transformer winding help? (R. J., El Arish, Qld).

● The points trigger circuit included the option for using two sets of points. If you are only using one set of points, then the second set of components (D13 and the 47Ω resistor) should not be included on the PC board. This option was mentioned in the parts list but perhaps was not made clear enough in the construction section of the article and overlay diagram.

Thanks for pointing out that transistor Q1 in the impulse tachometer circuit should be labelled a BC327 and not BC337 as shown.

Impulse tachometers can sometimes be difficult to drive when the original ignition system has been altered. This is because the tachometer may have been designed to detect the primary resonance of the ignition coil or it requires a slower or faster rise time from the coil.

We suggest that you experiment with the value of capacitance between the collector and emitter of transistor Q2. This will alter the rise time of the pulse.

SLA batteries need full charge

I was interested to read your article in the October 1998 issue regarding the use of SLA batteries for electronic flash guns. Have you ever run a similar article for camcorders? If not, let me tell you my story. I have a Sony CCD-F555E, bought in December 1992. It has a power consumption of 6.9W (in record mode), according to the owner's handbook.

Last year the three NiCd batteries which I bought in 1992 gave up the ghost, so I bought a 6V 4A.h SLA battery. I pulled the insides out of one of the NiCd battery packs to enable connection to the camcorder and tried to run it from the SLA battery. This battery was only able to run the camcorder for about five minutes before the "low battery" indicator lit up.

Several recharges using a charger designed for the battery failed to im-

prove the available recording time. Testing with a multimeter after charging showed a voltage of 6.7V and on failure to run the camera, about 6.2V. The wording on the battery indicated that up to 7.3V could be available. This didn't worry me since the mains adaptor supplied with the camcorder was rated at 7.2V.

Would a battery setup using a 12V SLA battery be feasible, or would the zener or other regulator use up too much of the battery's capacity to be worthwhile? In regards to a "proper" battery for the camcorder, I subsequently bought a 6V NiMH battery which has given very poor service and has been returned to the maker for inspection and testing.

None of the batteries which I have used with this camera have lived up to the performance I would have expected of them. Perhaps the camera is faulty and should be checked. The best performance was 60 minutes recording with a 2.2A.h NiCd about six months after I bought it, and using a discharger/charger to recharge it. (I. S., Castle Hill, NSW).

● 6.7V does not constitute a full charge for a 6V SLA battery. Full charge should be around 2.4V or more per cell, or around 7.2 to 7.3V. Your charger is clearly not doing the job. Perhaps you should build our Multi-Purpose Battery Charger, as described in the February 1998 issue.

Using a 12V battery and some sort of switchmode step-down circuit is a possibility but if your 6V battery is properly charged it should do the job.

Fast clock for model railways

I am a model railroader as well as a scale model builder and I looked at all your projects for model railways but the one thing that is lacking is a fast clock. This would enable running nights to be done to fast time instead of real time; eg, 12:1 fast time or 2 real hours = 24 scale hours. (R. S., Morphett Vale, SA).

● We published a project along these lines in the December 1996 issue of SILICON CHIP.

Gong circuit wanted

Can you please help me with a circuit to produce a gong type sound (similar to the start of Rank movies) each time a pushbutton is operated? It would need a variable frequency control and would be connected to an amplifier and speaker system. (R. M., Mount Duneed, Vic).

● While we have not published a circuit which meets your exact requirements, we did publish a Tom-Tom circuit in the May 1989 issue and this could be adapted to your application.

Query on phone battery charging

Having accepted the recent $10/month fee digital mobile network promotion to upgrade my ancient analog phone, I opted for Telstra's Motorola deal. My prime consideration in my choice of Motorola was the rather more reasonable $39.95 for an extra nickel metal-hydride battery.

After familiarising myself with and customising the great number of menu options on the keypad, I fashioned a simple 100Ω 0.25W resistor battery holder discharger since the manual recommended that discharge method; the manual also recommends a weekly complete discharge. I thought that NiMh cells had no memory effect, obviating the necessity for complete discharging.

A second annoyance was the prohibition on allowing the battery to be connected to the charger for longer than 24 hours. Where's this so-called smart chip technology? I thought I could plug the thing in and forget about it. Could you please give me the lowdown on NiMh cells? The customer service people at Motorola advised me not to use a 100Ω resistor discharge system since the higher capacity cells might reverse polarise the low capacity cells. (W. T., Oak Flats, NSW).

● One of our staff members has the same phone. As far as we can tell, you can just leave the phone on standby and it will turn itself off when fully discharged. Similarly, it only takes a few hours to charge and it cuts off when the battery is fully charged. Why would you leave it on for more than 24 hours and why worry about having another battery pack, unless you need to be contactable 24 hours a day?

Nickel metal-hydride cells apparently have greatly reduced memory effect compared to NiCd cells.

We would be wary about discharging the battery pack using a 100Ω resistor unless you ensure that you do not discharge below 1V/cell.

Problem with sound level meter

I have a problem with the Sound Level Meter as described in December 1996. I performed the calibration as per instructions with the following results: LED1 is lit, all ICs have close to either +9V or -9V (as appropriate) on their supply pins, the reference is -2.47V and pin 3 of IC4b has -18mV on it.

Using the pink noise source on the 0dB setting, VR2 was adjusted to 1.002V. Using the same source on 60dB setting, VR1 could only be adjusted down to a reading of 713mV, not 400mV as required. Any assistance would be most appreciated. (N. P., Seven Hills, NSW).

● There are several reasons why you cannot obtain the required 400mV from the output of IC3b when calibrating the instrument.

First, the output from your pink noise source may not be 60dB down when this selection is made. Check the values of resistance around attenuator switch S2 to ensure that this is correct.

Second, the output from the pink noise source may be excessively high due to an incorrect amount of amplification in either IC1a or IC1b. Check the resistor components around the feedback inputs for these amplifiers.

Third, on the Sound Level Meter, there may be an incorrect value of resistance used for VR1 or the feedback components around IC3b may be incorrect.

Fourth, check the gain of IC1a which should be x69 or measure its feedback resistor values at pin 2. Fifth, check all resistor values used around IC2, IC3a and IC4a. Finally, wind VR1 fully anticlockwise first, to obtain the maximum gain from IC3b. This should pro-

Interference to garage door opener

I recently built and fitted the garage door opener from your April 1998 issue. It works well with the exception of two faults. I decided to use a power supply instead of a 12V battery. As of yet I haven't fitted the remote. The problems I'm having are, firstly, if a light or an electrical tool such as a power saw is used, the door will open or close. For some reason the circuit is picking up an electrical signal which in turn operates the door. The second problem is that when the door is closing it will not stop when the limit is tripped (this only happens intermittently). The one microswitch is used for open or close.

I have a second garage door with a B&D door opener and two remotes. I thought that maybe I could change the code on one remote and reroute the received message through to the SILICON CHIP door opener. What do you think? The transmitter main IC is labelled B&D NSW serial TX 035966 and when this is peeled back its number is CD4067BL RCA 132. It also has an MC14624B and a CA555CE. The receiver has a CD4067BE RCA 749 and several other ICs. I tried some time ago to get some information on the circuit but was unsuccessful. Any light that you may be able to shed on this project would be appreciated. (A. K., Belmont, Vic).

● You now know why we chose a battery, apart from ensuring that the garage door opener works during blackouts. Running the microswitch leads in twin shielded microphone cable and earthing the screen to the negative (ground) of the PC board should cure the first problem. Looping the DC power leads a few times through a powdered iron ring (Jaycar LO-1244 or LO-1246) may also reduce mains interference.

The only reason we can suggest that the microswitch fails to work when the door in closing is that it is intermittently not being actuated. Without any mechanical details it is hard to be specific. The fact that it never misses in the up direction tends to indicate that the PC board is functioning OK.

The feasibility of using your B&D remote to operate the SILICON CHIP design depends on the compatibility of the codes of the MC14624 and the A5885 decoders. You could give it a try but we are not hopeful that it would work.

vide a voltage lower than the requisite 400mV during calibration.

Drift in digital voltmeter

I have built the Car Digital Voltmeter as described in the June 1993 issue of SILICON CHIP and have experienced drift with the readout. I recently checked the construction and can't find anything noticeably wrong.

If I let the meter stabilise overnight and then re-calibrate it I find that the unit still drifts high. Can you suggest a fix for this problem? The 7805 heatsink runs hotter than I expected even though you make mention of this in the construction details. (T. W., via email).

● There are two components most likely to cause a temperature drift: trimpot VR1 and transistor Q1. Try changing these.

Acoustic feedback in hearing aids

I wish to monitor the high frequency oscillation generated by behind-the-ear hearing aids. This whistling sound can sometimes be heard by others but not by the user. I bought the Sound Level Meter kit described in the December 1996 issue but I am hopeless with a soldering iron. A local electronics workshop quoted about $60 to assemble the kit but I do not know if it would meet my requirements. I would appreciate any advice. (P. M., Darwin, NT).

● We doubt whether this circuit will be able to discriminate between any feedback whistle and the general background noise. Any circuit to monitor acoustic feedback would need to be sensitive to the particular frequencies of the resulting whistle and be able to reject noise or any other sounds picked up by the hearing aid.

While such a circuit is feasible, we have not described anything which would be suitable for your purpose.

LED ammeter green LED always on

I have a problem with the LED ammeter described in the January 1999 issue of SILICON CHIP. Everything is fine with the circuit apart from the extreme RHS green LED being continuously on after power up. No amount of adjusting VR2 can change this.

I have replaced IC1 but it made no difference. I also noted that the 10µF electrolytic capacitor's positive electrode is connected to D1 in the overlay diagram but is connected to pin 4 of IC1 in the schematic. I oriented the capacitor this way but still no difference was evident. (N. P., via email).

● The 10µF capacitor should have its negative electrode connected to pin 4. The circuit diagram is wrong. Thanks for bringing this to our attention. As far as LED1 is concerned, when pin 5 of IC2 is at 0V, LED1 should be off. Adjust VR2 to get 0V at pin 5 of IC2. You can check this with your multimeter. Also check that -5V is present at pin 4 of IC1.

CDI system for an outboard motor

I am interested in the Multi-Spark Capacitor Discharge Ignition described in the September 1997 issue. Could you please advise the suitability of this unit for an old Chrysler 85 bhp 3-cylinder outboard motor. This motor previously had a Magnapower ignition installed.

If OK, what value should capacitor C3 be? You give values for 4, 6 & 8-cylinder motors. (W. B., via email).

● The Multi-Spark Capacitor Discharge Ignition system is suitable for an outboard motor provided that there is a suitable trigger signal from either points, reluctor, or Hall effect unit. Many outboard motors use a magneto which then fires an electronic mod-

ule. A second coil charges the discharge capacitor to a high voltage before triggering.

It may be possible to fire the unit using the reluctor input from the magneto. However, we have not tried this. A suitable capacitor for C3 should be 0.15µF.

UHF remote control for car alarm

In your August 1990 issue, you featured a transmitter which I bought from Dick Smith Electronics as a kit. I selected a code to work with my "commercial" car alarm. It works fine except that the range is a bit low (despite tweaking it on a spectrum analyser).

I haven't seen the circuit for your 2-channel UHF transmitter (also avail from Dick Smith Electronics) but can you tell me:

(1) Does it transmit on the same frequency?

(2) Does it use the same encoder chip?

(3) Does it have a greater range?

(4) Will it therefore work (1-channel of course) with your old UHF remote control receiver kit?

(O. W., via email).

● The 2-channel transmitter transmits at 304MHz but does not use the same encoder. We expect that it has a similar range to the earlier design but cannot state whether it could be made to work with your car alarm.

Enhancing the class-A amplifier

I have a few questions regarding the 15 watt class-A amplifier project. I wish to provide extra inputs for CD, tuner, stereo VCR and tape in/out sockets. The plan is to use gold RCA input sockets on the back panel. These would be selected via two rotary switches mounted toward the back of the case and controlled by an extension shaft to keep the wiring for the inputs as short as possible.

If I take this approach are the performance figures likely to be degraded? All other construction details would be as per the article.

One final question: was the rack case used in the prototype a commercially available unit or was it built from scratch to incorporate the two heatsinks? (J. W., Five Dock, NSW).

● Provided your input switching is well-shielded, it should not degrade the amplifier's performance. Our case was an obsolete rack case to which we attached the heatsinks. **SC**

Notes & Errata

Low Distortion Audio Signal Generator, February & March 1999: on the circuit diagram on page 28 of the February issue, trimpot VR4 is incorrectly labelled as 100kΩ rather than 10kΩ.

Also on the circuit there should be shown a 10kΩ resistor in between the 20kΩ resistor connecting to the 330µF capacitors at the output of IC1b and the pin 2 inverting input of IC4b. The PC board includes this resistor and this is shown on the overlay diagram, on page 63 of the March issue, as the third 10kΩ resistor below diode D2.

The overlay diagram also has transposed the anode and cathodes (A & K) labelling for LED1 & LED2. The package outline orientation is correct. The polarity shown on the circuit is also correct.

Electric Fence Controller, April 1999: the supply leads to the battery, as shown on the wiring diagram on page 28 (Fig.7) are reversed.

In addition, the transformer bobbins for T1 & T2 may differ from those used in our prototype. The difference will be that the five rows of pins on each bobbin may be spaced wider than allowed for on the PC board. You can either bend the pins on the bobbin inward so that they will fit into the original holes or new holes can be drilled at the wider spacing.

The larger bobbins mean that the transformers will be easier to wind and there will be more room to insert the ferrite cores. A revised PC board has been produced to provide for both bobbin types.

Multi-Spark CDI, September 1997: transistor Q1 in the impulse tachometer circuit on page 30 should be labelled a BC327 and not BC337 as shown.

LED Ammeter, January 1999: the circuit diagram on page 55 has an error. The 10µF capacitor associated with IC1a should have its negative electrode connected to pin 4.

Capacitance Meter, February 1999: the wiring diagram on page 70 has a number of errors. The 100µF capacitor associated with D1 & D2 is unmarked and is shown with reverse polarity. Also VR3 & VR4 are swapped, although their values are the same.

Bass Cube Subwoofer, April 1999: the rear panel should be screwed into place but not glued, although some sort of sealant should be used to avoid leaks.

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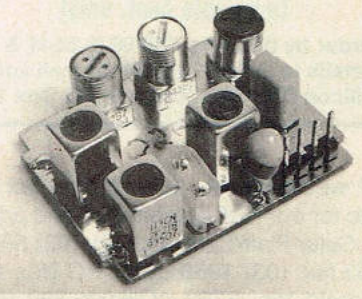

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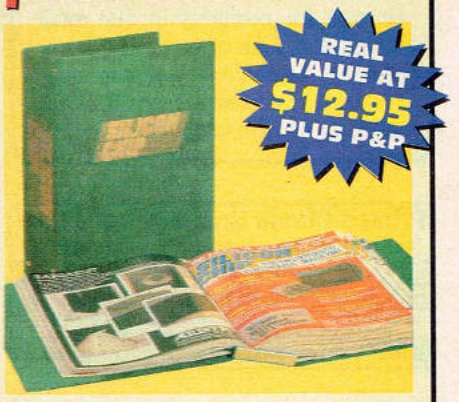

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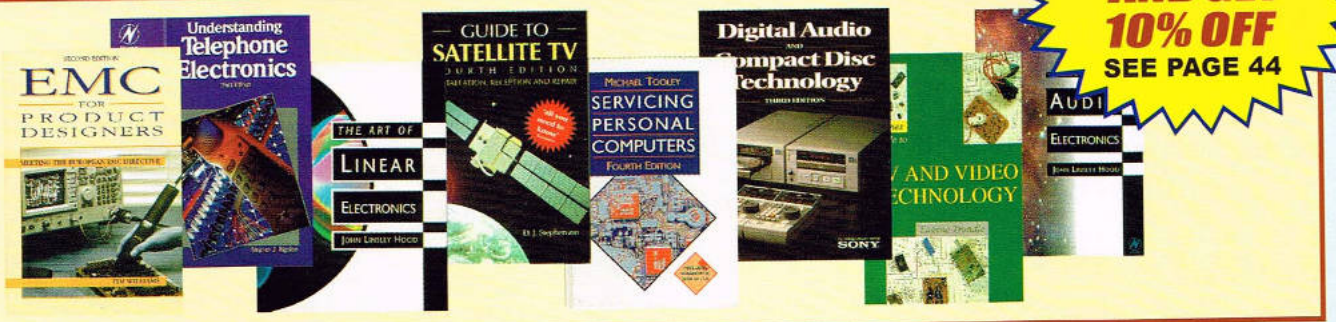

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